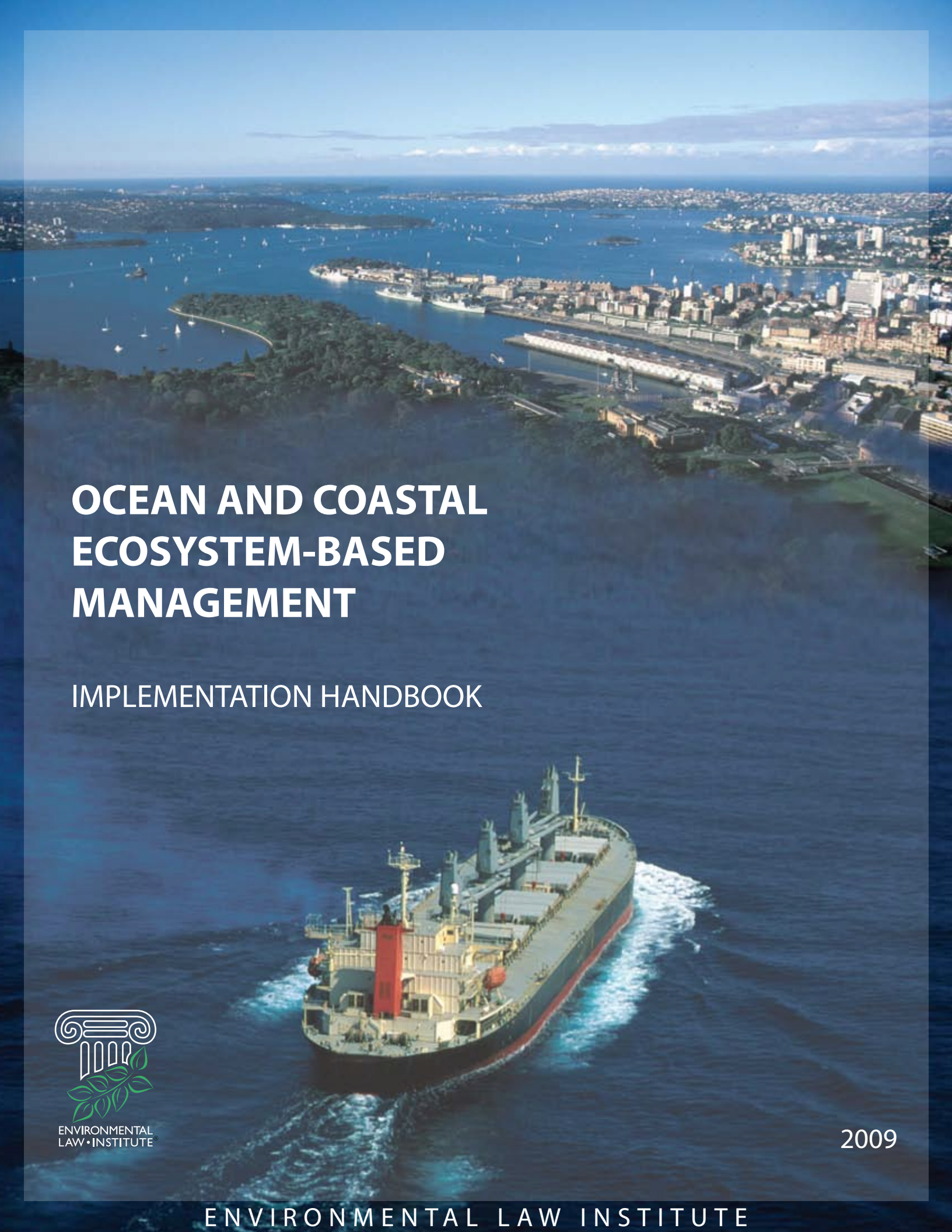

OCEAN AND COASTAL ECOSYSTEM-BASED MANAGEMENT

IMPLEMENTATION HANDBOOK

ENVIRONMENTAL LAW • INSTITUTE®

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Ocean and Coastal Ecosystem-Based Management: Implementation Handbook

Environmental Law Institute

2009

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- *Managing for a Healthy Gulf of Mexico Ecosystem* in partnership with Dr. Richard McLaughlin (Harte Research Institute for Gulf of Mexico Studies), November 2007
- *Managing for a Healthy California Current Ecosystem* in partnership with Dr. Harry N. Scheiber (Law of the Sea Institute in the Institute for Legal Research at UC Berkeley), April 2008
- *Mid-Atlantic Regional Ocean Forum* in partnership with Mr. Jay Odell (The Nature Conservancy), Dr. Biliana Cicin-Sain (Gerard J. Mangone Center for Marine Policy, University of Delaware), Mr. Tony MacDonald (Urban Coast Institute, Monmouth University, New Jersey), Ms. Kristen Fletcher (Coastal States Organization), and Ms. Laura Cantral (Joint Ocean Commission Initiative), December 2008

These meetings provided diverse and informative viewpoints, experiences, and perspectives on the need for and ways to implement ecosystem-based management. Many of the examples in this report were identified in the course of discussions at the regional and working group meetings.

About ELI Publications—
ELI publishes Research Reports that present the analysis and conclusions of the policy studies ELI undertakes to improve environmental law and policy. In addition, ELI publishes several journals and reporters — including the Environmental Law Reporter, The Environmental Forum, and the National Wetlands Newsletter — and books, which contribute to education of the profession and disseminate diverse points of view and opinions to stimulate a robust and creative exchange of ideas. Those publications, which express opinions of the authors and not necessarily those of the Institute, its Board of Directors, or funding organizations, exemplify ELI's commitment to dialogue with all sectors. ELI welcomes suggestions for article and book topics and encourages the submission of draft manuscripts and book proposals.

Ocean and Coastal Ecosystem-Based Management: Implementation Handbook

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EXECUTIVE SUMMARY

The Environmental Law Institute (ELI) produced this Handbook to identify successful approaches to implementing marine ecosystem-based management (EBM), describe their limitations, and highlight opportunities to apply them in the future. There is no single perfect example of EBM implementation. Therefore, this Handbook provides a spectrum of examples that take steps toward EBM, all of which have their strengths and weaknesses. It also describes new ideas about how to achieve success with EBM implementation that may not yet exist in practice. The Handbook is designed to share a variety of approaches that may be useful in different settings depending upon regional needs and opportunities.

In an ideal world, robust scientific information would inform the development of a common regional vision and plan for a healthy and resilient ocean and coastal ecosystem. The vision and plan would set clear goals for maintaining the full suite of ecosystem services, while taking into consideration social, economic, and environmental needs. Mechanisms would be in place to monitor efforts, determine success, and revise activities based on review of the program. Resource managers, planners, and decision-makers would use the plan as the basis for minimizing cumulative impacts that occur over time, across the ecosystem, and across sectors. The plan also would serve as the basis for making tradeoffs within and across sectors. And at all stages, the process would be transparent and participatory.

Rather than cover all the multiple aspects of EBM, we focused on five specific challenges to EBM implementation and governance that arose repeatedly in the course of our research, interviews, and working group meetings. These are: (1) developing an ecosystem-based vision and plan; (2) incorporating ecosystem science and information into management decisions; (3) creating accountability and adaptive management for executing ecosystem plans; (4) addressing cumulative ecosystem impacts within and across management sectors; and (5) making tradeoffs among competing and/or conflicting ocean uses. Each is given its own Chapter in the Handbook, and summarized in this section.

ECOSYSTEM-BASED VISION AND PLANNING

Central to ecosystem-based management is the need to develop a common vision of a healthy and resilient marine environment that considers the ecosystem, society, and the economy; as well as a plan of action to achieve that vision. To be EBM-focused, the regional vision should consider the needs of the ecosystem, society, and the economy, and strive to maintain the full suite of ecosystem services upon which humans rely. From such a vision, the regional actors should collaboratively develop an implementation plan that prioritizes actions and has specific,

tangible, and measurable objectives. The vision and implementation plan set the stage for an effective adaptive management program.

Obstacles that may prevent development and implementation of a truly ecosystem-based plan include: lack of capacity to achieve objectives; agency mandates or primary objectives that prevent EBM implementation; and lack of common objectives across a region.

Chapter II considers the following procedural aspects to planning and specific approaches to developing plans:

(1) Overall planning approaches.
(2) Develop a regional vision.
(3) Conduct threats analysis.
(4) Identify concrete goals and measurable indicators.
(5) Develop an implementation plan.

An EBM vision should be the result of agreed common goals and strategies of the region and should help guide the overall program toward an ecosystem-based approach. EBM is a process to achieve a certain result; therefore, EBM should not be undertaken simply for the sake of doing EBM. Instead it should target specific threats to ecosystem health and resilience.

In practice, the drivers for program development often are resource degradation and the need to restore ecosystem damage. In some places, however, state governments are working toward maintaining or enhancing ocean ecosystems and have passed laws to help plan for and manage new and expanding ocean uses. In both situations, achieving EBM is not the goal. Rather, the goal is to use this science-based collaborative approach to achieve the goals of maintaining, enhancing, or restoring ecosystem function in the face of existing and new ocean uses.

The planning process must include the appropriate regional institutions and stakeholders in order to develop a legitimate process, including non-traditional participants whose activities affect the ocean such as the transportation sector and the agricultural sector. To create an effective plan that is designed to support healthy and resilient ecosystems, a strategic and adaptive planning process is essential.

A threats assessment should help guide the development of concrete goals and measurable indicators. Expressing specific indicators to measure success enables adaptive management and creates a mechanism for the EBM program and other stakeholders to evaluate whether the program is accomplishing its goals. To be effective, indicators should inform management action and be linked to the overall ecosystem goals.

Implementation plans can drive collective action, and with the right elements can support adaptive management processes and accountable governance systems. In addition to sharing a

vision, identifying concrete goals and measurable indicators for success, common plan elements include: designation of lead agencies for a description of the legal authority under which action can be taken or a memorandum of understanding to delineate partnerships; and implementation cost estimates and funding sources.

ECOSYSTEM SCIENCE AND INFORMATION

Science-based natural resource management often considers species- or sector-specific information but falls short of achieving a comprehensive understanding of the myriad components that interact to form a healthy ecosystem. Furthermore, even the most basic information about physical structure, physical processes, and ecology is limited at best. EBM programs can and do take a variety of approaches toward accessing or developing the data needed to make effective decisions. Potential ways to further develop and utilize ecosystem science in decision-making include the following approaches:

(1) Incorporate scientific decision-making throughout the EBM program.
(2) Use available data to inform management decisions.
(3) Collect new data to inform management decisions.
(4) Share information across sectors and jurisdictions.

Ecosystem-based management requires an understanding of ecosystem structure, function and processes in order to make the appropriate management decisions. Thus, science-based decision-making is an essential aspect of EBM. Existing scientific committees or structures may already be poised to serve as advisors to a regional ocean governance program. In the absence of existing bodies, a new science committee could serve as an important link to the scientific community and support science-based decision-making.

While a great deal of data is available, it may not be effectively connected to the decision-making system. Especially important is the need to take advantage of long-term data sets and continued monitoring efforts as a way to understand baselines and evaluate management success. Also, creating digital maps of social and ecological information is an increasingly important way to communicate EBM data to managers, decision-makers, and stakeholders.

New data and existing data should inform management decisions. Ways to enhance data collection and integration with management including research planning based on EBM needs, establishing mechanisms to transfer new information to managers, and identifying legal mechanisms to enhance data collection by resource users.

One of the major challenges with regional ecosystem science is the lack of a common source of information. Also, without proper communication and collaboration, agencies may not fully utilize data from other agencies or academic institutions or may conduct redundant research.

ACCOUNTABILITY AND ADAPTIVE MANAGEMENT

Ecosystem-based management relies on mechanisms to ensure that institutions participate in EBM and are held accountable to the regional programs. Also, regional programs must be held accountable to higher levels of government and ultimately to the communities they represent.

Closely tied to accountability is the need to have a management system that adapts to new information and changing conditions. Thus, this chapter addresses both accountability and adaptive management together.

Several implementation challenges can be linked to the need for better accountability. Institutions often lack a clear legal mandate or the authority to achieve EBM objectives. Sector-based laws, regulations, and policies may conflict with regional objectives. Finally, an absence of meaningful reporting mechanisms can prevent transparency and accountability. Accountability approaches that help overcome these challenges include:

(1) Governance structure
(2) Planning requirements
(3) Implementation approaches

Implementing EBM plans once they are established is one of the chief challenges seen in many regions. Governance programs can create processes and structures to help achieve accountability. Key approaches include developing appropriate mandates or founding documents, establishing an adaptive management process, and ensuring meaningful public participation. Also, properly developed plans help achieve accountability and support adaptive management.

CUMULATIVE IMPACTS

More than a restructured governance system, EBM is a management approach that seeks to minimize human impacts to the marine environment that result in loss of ecosystem services. Effective management of the marine environment should consider cumulative impacts and make decisions that minimize these impacts so that marine ecosystems remain healthy and resilient.

One way that government agencies manage ecosystems is by managing the activities of the people who use them. Several approaches are possible. Some activities may take place in the absence of any regulatory framework. More often, government agencies regulate human uses through the use of a permitting system. In other cases, laws and policies may be designed to encourage certain behaviors or activities through incentive-based programs. And some locations may be completely protected and off-limit to all human uses, while certain activities may be completely prohibited no matter the location.

This Chapter considers the following three broad mechanisms to address cumulative impacts:

(1) Preservation by Limiting or Prohibiting Human Use
(2) Allowing Sustainable Human Use
(3) Restoring Ecosystems after Degradation

Preservation by withholding areas from human use is a traditional means of minimizing human impact. This includes, for example, establishment of federal or state protected areas or the use of private mechanisms such as easements or land acquisition to protect regions. However, this approach has limited utility since most of the ocean and coastal environment is and likely will not be designated for preservation. In an EBM context, preservation approaches can be one way among many to reduce human impact.

Most ocean and coastal areas are available for human development or use to some extent. Thus, a key to effective minimization of cumulative impacts is the development or application of approaches that allow sustainable use. Challenges to this approach include a lack of scientific data and models that can properly support cumulative impact analysis and decision-making, and an existing legal and regulatory framework that reacts to use and development on a case-by-case and/or sector-by-sector basis.

While preventing degradation is a key need, the reality is that many important ocean and coastal ecosystems or parts of these ecosystems are already degraded. A review of existing regional ocean governance programs, in fact, reveals programs that are largely focused on restoration.

TRADEOFFS

Closely linked to the need to reduce cumulative impacts is the need to make explicit tradeoffs among potentially competing or conflicting ocean and coastal uses. Done correctly, creating a system to make tradeoffs should lead to management that (1) addresses cross-sector ecosystem impacts; (2) is fair; and (3) enables the identification and implementation of win-win scenarios. There are few existing regional ocean management programs that make proactive tradeoffs among potentially competing and/or conflicting uses.

This section focuses on the identification and use of proactive tradeoff approaches that could be incorporated into EBM systems:

(1) Value Societal, Economic, and Ecosystem Benefits and Harms
(2) Make Explicit Tradeoffs
(3) Resolve Disputes

A primary goal of EBM is to conserve ecosystem services—benefits provided to humans by the ecosystem, including provisioning, regulating, cultural, and supporting services. Developing mechanisms to value ecosystem services through quantitative scientific processes, as well as public processes, can help lay the groundwork for making explicit tradeoffs among potentially competing and/or conflicting uses.

In most situations, society makes inadvertent or implicit tradeoffs among ocean and coastal uses without specifically considering the benefits and harms of all foreseeable uses. This can lead to loss of ecosystem services and an unfair process of establishing access and rights to resources

A system of tradeoffs can help minimize later disputes. However, as EBM plans are implemented and more information is learned, disputes will likely arise.

I. INTRODUCTION: KEY COMPONENTS OF OCEAN AND COASTAL ECOSYSTEM-BASED MANAGEMENT

"Ecosystem-based management is an integrated approach to management that considers entire ecosystems, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans want and need. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors."

--Scientific Consensus Statement on Marine Ecosystem Based Management[1]

A. The Need for Ecosystem-Based Management

Human Activities and Ecosystem Challenges

In 2002, 775,000 salmon returned to California rivers to spawn. In 2008, scientists predicted only 58,200 would return. In response to this population decline, the Pacific Fishery Management Council announced the closure of the California salmon fishery. What is the cause? According to a Council press release, "[m]any biologists believe a combination of human-caused and natural factors are to blame, including freshwater in-stream water withdrawals, habitat alterations, dam operations, construction, pollution, and changes in hatchery operations."[2] In response the Council requested the development of a task force to examine all the possible causes.

While these causes are under investigation, what is the solution? By itself, the Pacific Fishery Management Council has one option: reduce fishing pressure. The available solution is single-sector, but the actual causes may be many. This raises two issues. First, fairness—is it fair to put the entire burden of the resource decline on fishers when they are one among several potential causes? And second, assuming the decline is caused or exacerbated by human activities other than fishing, will a reduction in fishing solve the problem or simply manage a declining stock?

The salmon collapse in California encapsulates the challenge that ecosystem-based management (EBM) strives to address—how to manage for the overall health of the ocean and coastal

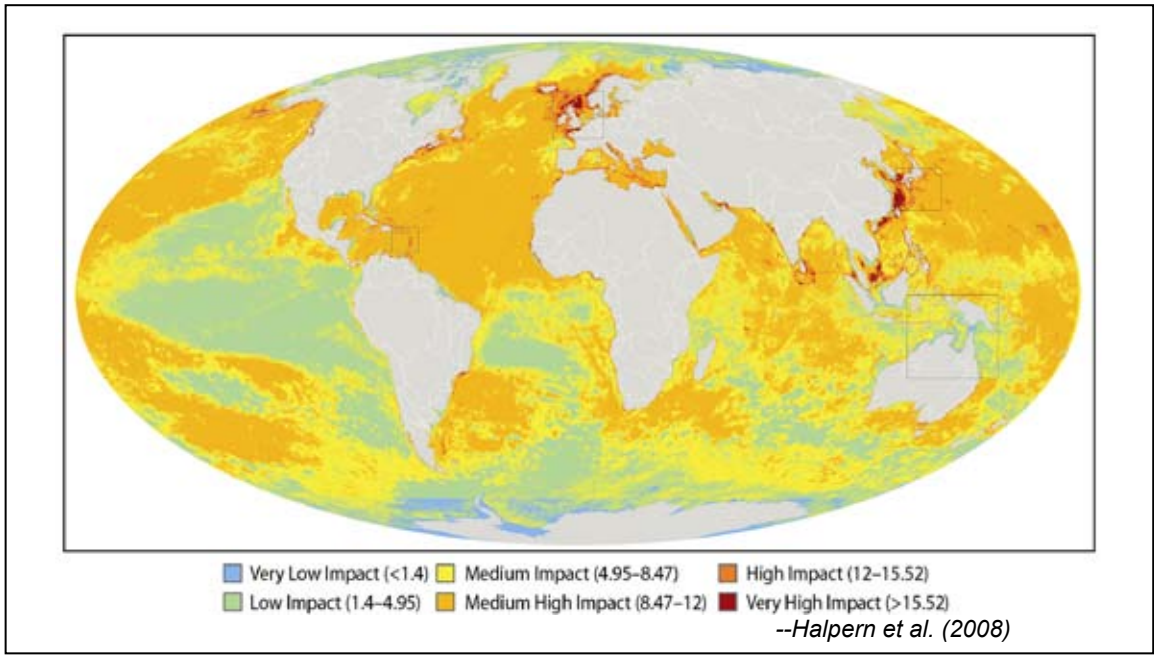
1 Karen McLeod et al., Scientific Consensus Statement on Marine Ecosystem-Based Management (2005), *available at* http://compassonline.org/?q=EBM.

2 *See, e.g.,* Anon., *PFMC Meeting to Set Fisheries; Seeks Task Force on Causes for Decline*, Columbia Basin Fish & Wildlife News Bulletin, Mar. 21, 2008, *at* http://www.cbbulletin.com/free/266402.aspx.

environment, considering multiple ecosystem impacts across time and space in a way that explicitly and transparently makes tradeoffs among potentially competing uses.[3]

Figure 1 is a map of human impacts on the marine environment, demonstrating that more than 40 percent of the world's oceans experience major impacts from a range of human activities that includes fishing, shipping, land-based sources of pollution, and other uses.[4]

Figure 1. Human Impacts



Halpern et al. (2008) developed threat maps for 17 different human activities such as fishing, climate change, and pollution across 14 different marine ecosystems. The authors combined this information to develop the cumulative impact map shown here.

As a result of the human impacts on the marine environment, many marine and coastal ecosystems no longer deliver the full suite of ecosystem services upon which humans have come to rely. A primary goal of marine ecosystem-based management is to conserve ecosystem services,[5] which are the benefits provided by ecosystems.[6] This approach to marine management

3 McLeod et al., *supra* note 1.

4 Benjamin Halpern et al, *Global Map of Human Impact on Marine Ecosystems* [hereinafter *Global Map*], 319 Science 948 (2008).

5 Andrew A. Rosenberg, *Regional Governance and Ecosystem-Based Management of Ocean and Coastal Resources: Can We Get There From Here?* 16 Duke Envtl. L. & Pol'y F. 179 (2006), *available at* http://www.law.duke.edu/shell/cite.pl?16+Duke+Envtl.+L.+&+Pol%27y+F.+179#F4.

6 Millennium Ecosystem Assessment, Ecosystems and Human Well-Being: Synthesis 39 (2005), *available at* http://www.millenniumassessment.org/documents/document.356.aspx.pdf.

strives to preserve all ecosystem services, including those benefits that support human well-being. The Millennium Ecosystem Assessment identifies four categories of ecosystem services: provisioning services, regulating services, cultural services, and supporting services.[7] Provisioning services are the products supplied by ecosystems. Oceans and coasts offer a wide range of food, and coastal wetlands provide fresh water. Many genetic resources, biochemicals, and medicines also are derived from the marine environment.

Regulating services are the benefits obtained from natural regulation by ecosystem processes. The marine environment plays an essential role in climate by acting as a sink for carbon dioxide and heat. Coastal wetlands purify water and even out water flow. Coastal ecosystems and coral reefs protect coastal areas from natural hazards and shoreline erosion.

Cultural services are the nonmaterial benefits people gain from ecosystems. The marine environment provides a place for recreation and ecotourism. Cultural heritage and social relations, such as the customs and traditions of fishing communities, are often tied to coastal and ocean ecosystems.

Supporting services are benefits that are necessary for the continuance of other ecosystem services. Many photosynthetic organisms live in marine ecosystems, providing oxygen and serving as a foundation for the food chain. The marine environment and coastal wetlands additionally maintain nutrient cycles upon which a wide range of ecosystems depend.[8]

An example of the loss of marine ecosystem services is a study of 200 years of human impact in the Bay of Fundy. The study reveals that 60-90 percent of wetlands have been lost; three marine mammals were hunted to extinction; and fish stocks have been reduced substantially.[9] These losses translate to losses in provisioning, regulating, supporting, and cultural services once provided by the ecosystem.

Human use of the ocean and coastal environment includes a broad range of activities that may compete for resources and space. Figure 2 is a location map of the Neptune liquefied natural gas terminal and pipeline, which will be completed in 2009.[10] It demonstrates the legal and regulatory complexity and use designations in this multi-use environment. Missing from this map, which adds to the complexity, are human activities such as fishing and whale watching, designated dredge disposal sites, and the many habitats and species that are found in this busy region.

7 *Id* at 40.

8 *Id*. at 40.

9 Heike K. Lotze and Inka Milewski, *Two Centuries of Multiple Human Impacts and Successive Changes in a North Atlantic Food Web*, 14 Ecological Applications 1428 (2004).

10 Ecology & Environment, Inc., Location Map of Neptune Subsea Pipeline and Off-Shore LNG Terminal (to be operational in 2009) (on file with authors; reprinted with permission from Suez LNG NA LLC and Ecology and Environment Inc).

Figure 2. Location Map of Neptune Subsea Pipeline and Off-Shore LNG Terminal

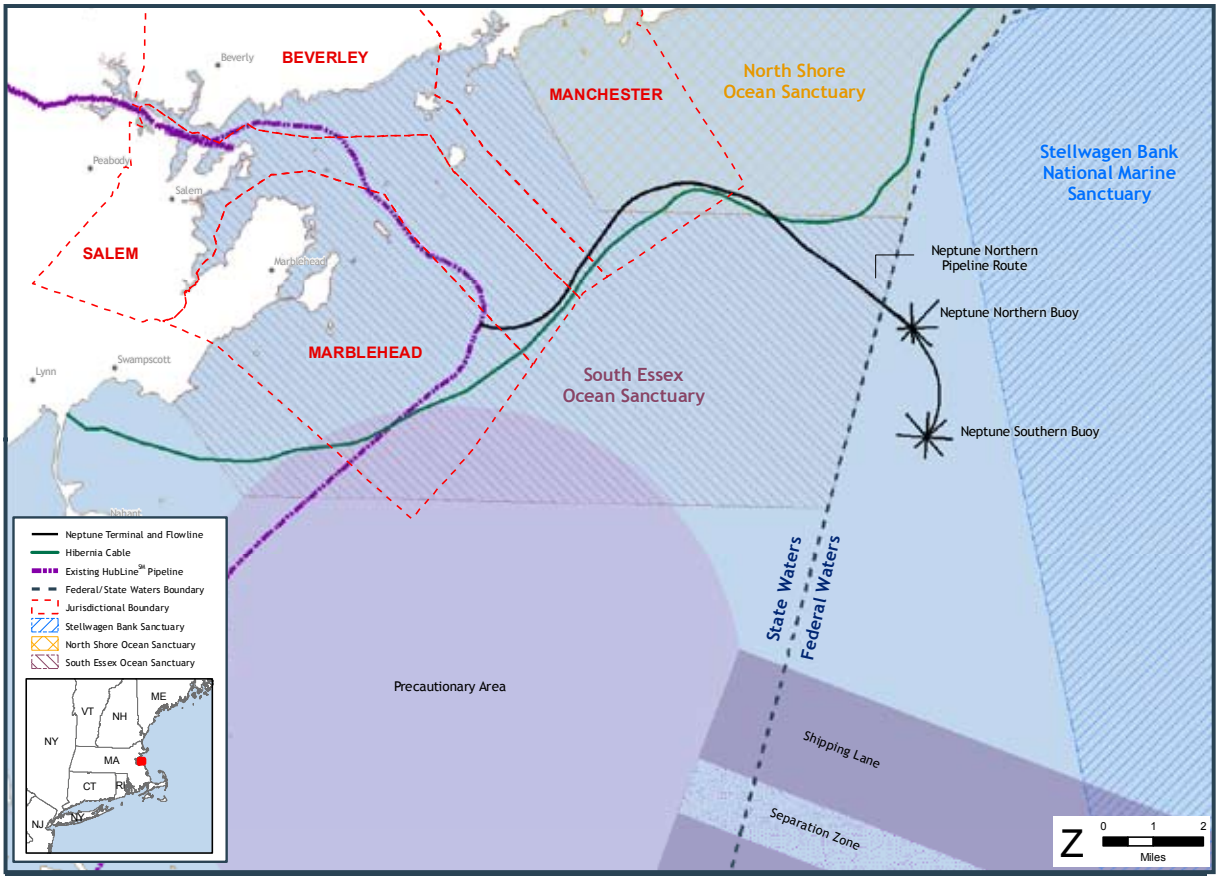


Figure 2 demonstrates the legal and regulatory complexity of the multi-use environment surrounding Boston Harbor. Ocean activities include fishing, whale watching, shipping, dredge operations, and LNG transport. Area designations including shipping lanes and state and federal sanctuaries. Local, state, and federal jurisdictions are noted.

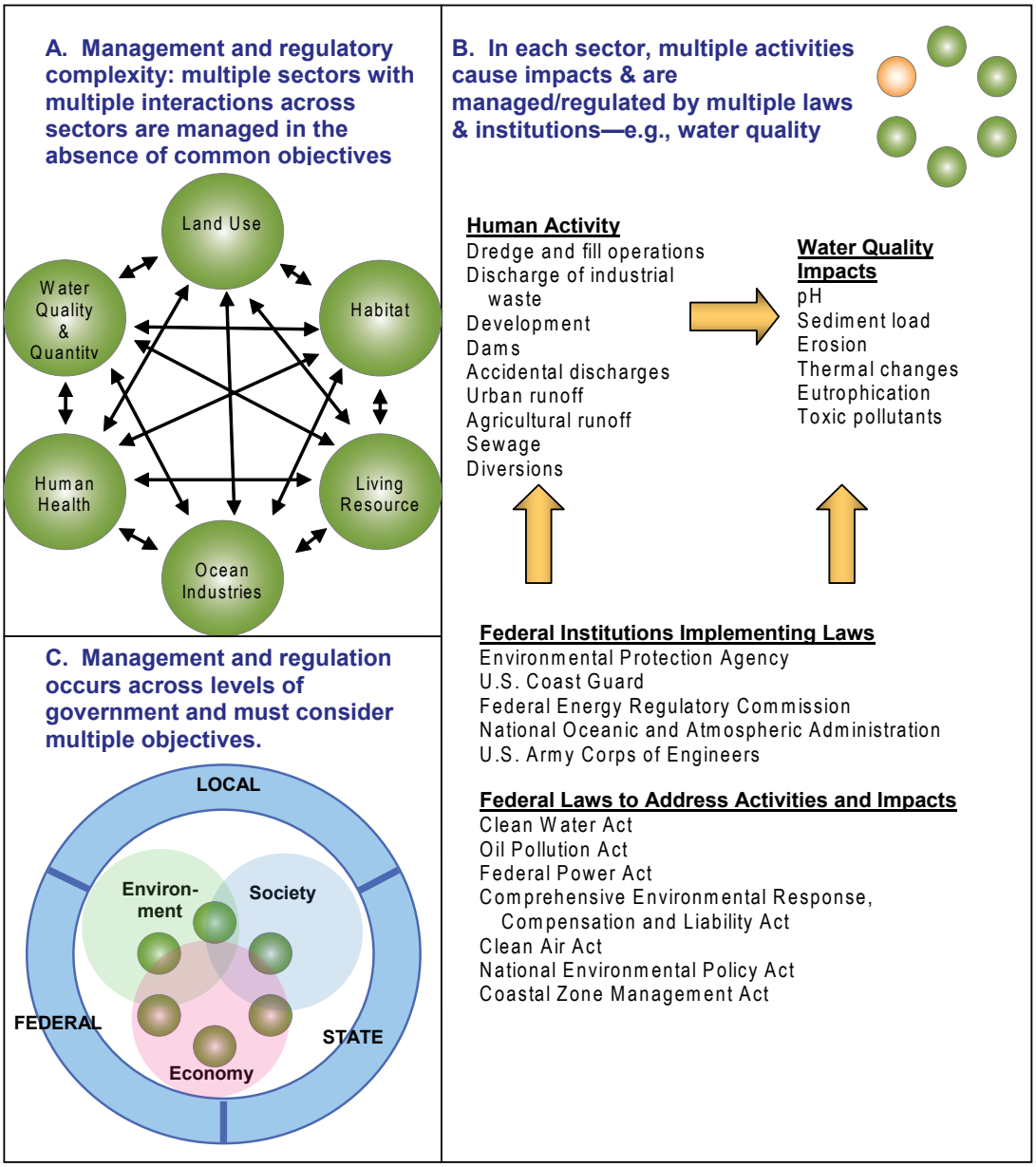
Governance Challenges

The current system of governance makes it extraordinarily difficult to effectively manage ocean and coastal ecosystems for sustainable use. First, management and regulation occurs in sector-based silos (Figure 3A). This Handbook considers six sectors: (1) land use; (2) habitat; (3) water quality and quantity; (4) human health; (5) living resources; and (6) ocean industries. This is just one of many possible ways to divide the different ocean uses that occur every day.

Within each sector, multiple activities cause impacts and are managed by multiple laws and institutions (Figure 3B). While often considered in isolation, these various sectors interact to affect the same environments and also are affected by the laws, policies, and management of different sectors (Figure 3A).

In addition, management and regulation occur across different levels of government, and each managing or regulatory institution must consider the multiple objectives of society, environment, and economy in the decision-making process (Figure 3C). This complex system of government makes it challenging to maintain ecosystem health and resilience in order to maximize the full suite of ecosystem services provided by ocean and coastal environments.

Figure 3. Management Silos and Complex Systems



In addition to complex governance and the lack of coordination and cooperation among management and regulatory institutions, there are many legal, regulatory, and implementation gaps that inhibit our ability to comprehensively manage ocean and coastal environments. Table 1 provides an example of common gaps within a single sector—water quality management.

Table 1. Legal and Regulatory Gaps in Water Quality Management

1. States/EPA set water body standards (designation and criteria to support designation) GAP: Standards not necessarily based on goal of maintaining a full suite of ecosystem services. GAP: Designations may be single-scope in objective (however, some are based on a measure of ecosystem function)
2. States/EPA determine if water bodies are impaired. GAP: Impairment determined on a pollutant-by-pollutant basis, not overall ecosystem health. GAP: Water bodies are often divided into segments and evaluated on a segment-by-segment basis, which does not effectively consider linkages throughout the watershed.
3. If impaired states/EPA develop a report of the impairment and a plan to address impairment (called a total maximum daily load (TMDL)). GAP: A plan is only created after a waterbody is impaired or threatened with impairment, not as a proactive approach to maintain a healthy ecosystem. GAP: There are few legal requirements to implement the plan.
4. States/EPA regulate pollutant discharge from point sources. GAP: The Clean Water Act only requires permits for point sources of pollution, not non-point sources. This leaves out major pollutant sources including, for example, agriculture, runoff, and air pollution.

Many legal and regulatory gaps and conflicts exist among management sectors and institutions. One of the biggest gaps is the inability to minimize cross-sector cumulative impacts and to make tradeoffs among the uses that impact the ocean and coastal ecosystems in a comprehensive and forward-looking way. Because there are no mechanisms to address these impacts collectively and make explicit tradeoffs, the ability to achieve sustainable use is limited.

One of the best examples of regulatory overlap is related to hydrokinetic energy development on the ocean. Under the Energy Policy Act of 2005, the Department of the Interior has the authority

to regulate alternative energy on the Outer Continental Shelf (beyond 3 miles offshore).[11] The Federal Energy Regulatory Commission (FERC) claims authority to regulate hydrokinetic energy (wave, tidal, and current energy) under the Federal Power Act in state and federal waters. This conflict has been minimized by a recent memorandum of understanding between the FERC and Department of the Interior, which gives FERC licensing authority and the Department of the Interior leasing authority.[12]

B. Overview of Ecosystem-Based Management

Ecosystem-based management is an approach that focuses on managing the many human activities that impact the ocean and coastal environment to maintain the health and resilience of the ecosystem and the full suite of services it provides. This means properly managing human activities across time, space, and sectors to minimize the cumulative impacts that degrade ecosystem health and function.

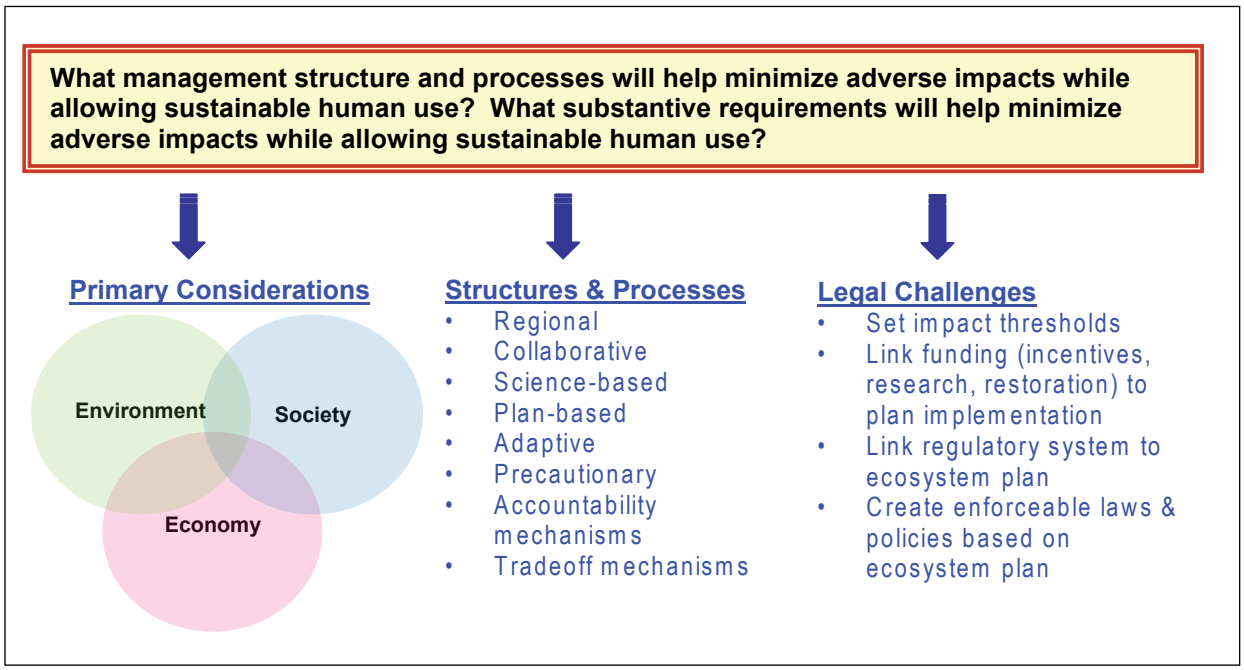
As Figure 4 illustrates, two major governance questions emerge: (1) what management structures and processes will help minimize adverse impacts while allowing sustainable human use; and (2) what substantive requirements will help minimize adverse impacts while allowing sustainable human use?

An EBM approach to these questions would consider the inter-relationships of the environment, society, and economy in formulating solutions. Its structure and processes are typically envisioned as regional, collaborative, science-based, plan-based, adaptive, and precautionary with robust mechanisms to create accountability, make tradeoffs, and minimize cumulative impacts. This Handbook further considers the legal challenges for this including how to set impact thresholds, link funding to plan implementation, link the regulatory system to ecosystem plans, and create enforceable laws and policies based on ecosystem plans.

11 Federal waters begin 9 miles offshore for Texas and the Gulf Coast of Florida.

12 Memorandum of Understanding between the Department of the Interior and Federal Regulatory Energy Commission (2009), *available at* http://www.ferc.gov/legal/maj-ord-reg/mou/mou-doi.pdf.

Figure 4. Minimizing Adverse Human Impacts and Enhancing Positive Impacts



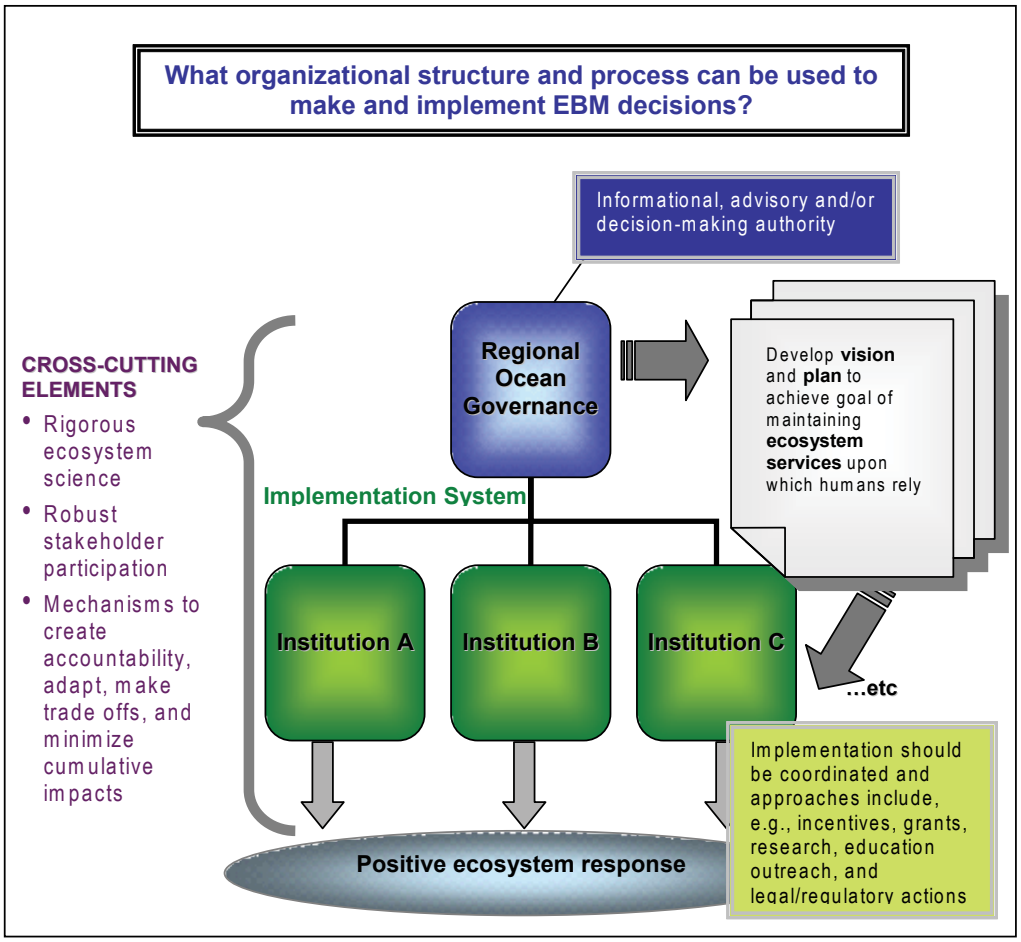
In an ideal world of EBM, robust scientific information would inform the development of a common regional vision and plan for a healthy and resilient ocean and coastal ecosystem. The vision and plan would set clear goals to maintain the full suite of ecosystem services, while taking into consideration social, economic, and environmental needs. Mechanisms would be in place to monitor efforts, determine success, and amend activities based on review of the program. Resource managers, planners, and decision-makers would use the plan as the basis for minimizing cumulative impacts that occur over time, across the ecosystem, and across sectors. The plan also would serve as the basis for making tradeoffs within and across sectors. And at all stages, the process would be transparent and participatory.

This Handbook focuses on the elements of EBM that relate directly to governance—specifically setting goals and priorities, some elements of monitoring and assessment, and making and implementing EBM decisions (Figure 5). Regional ocean governance can provide a framework to integrate of ocean and coastal management across jurisdictions and sectors to achieve a healthy and resilient marine ecosystem.[13] In practice, regional ocean governance bodies vary in their capacity—ranging from informational and advisory to having full regulatory and decision-making authority.

13 *See, e.g.*, Joint Ocean Commission Initiative & Monterey Bay Aquarium, An Agenda for Action: Moving Regional Ocean Governance from Theory to Practice (2007); *see also* Ingrid Nugent & Tim Profeta, Pathway to Ocean Ecosystem-Based Management: Design Principles for Regional Ocean Governance in the United States 3 (2006), *available at* http://www.nicholas.duke.edu/institute/oceanesm.pdf.

This Handbook presents a range of regional ocean governance approaches. It should also be noted that regional ocean governance is not the same thing as EBM and can exist in the absence of an EBM program. For example, a regional ocean governance program could aim to achieve a specific objective such as short-term economic growth. However, regional ocean governance is a core element of EBM implementation in practice. To be considered EBM as envisioned by current practitioners, the program should be based on rigorous ecosystem science, include robust stakeholder participation, and ensure that the full suite of ecosystem services remains intact in a sustainably used ecosystem. It is a system that involves tradeoffs among ocean uses and minimization of cumulative impacts. It is necessarily adaptive.

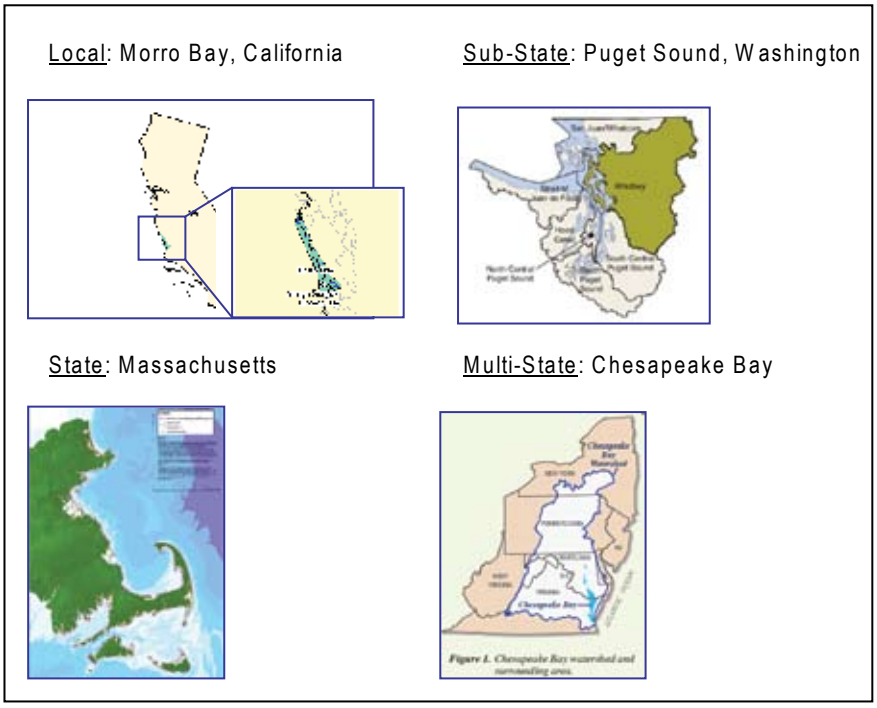
Figure 5. EBM Program—Organizational & Structural Elements



In existing EBM-like efforts, regional ocean governance bodies are the central organizing bodies that allow stakeholders, agencies, and other institutions to share information, develop ecosystem visions and plans, and develop strategies to implement the plans. This figure shows common structural and organizational elements. The following chapters build upon this diagram to demonstrate information flows and key processes essential to EBM implementation success.

In this Handbook, "region" is meant to connote the full spectrum of program sizes, not simply multi-state efforts (Figure 6). Existing U.S. regional ocean governance approaches include large-scale multi-state efforts such as the Chesapeake Bay Program, the West Coast Governors Agreement, and the Gulf of Mexico Alliance; single-state approaches such as the Puget Sound Partnership, the California Ocean Protection Council, and the Massachusetts Ocean Partnership; and small scale programs like the San Luis Obispo Science and Ecosystem Alliance, the San Juan Islands program, and the Elkhorn Slough EBM program. All of these programs focus on managing the needs of development and resource use with sustainability and conservation. They and other programs, along with sector-specific ecosystem-approaches provide the basis of the information contained in this Handbook.

Figure 6. The Size of the Governance Region Depends on Program Scale—Examples



Morro Bay map from EPA, Surf Your Watershed. Puget Sound map from the Puget Sound Partnership, highlighting one of seven action areas (see http://www.psp.wa.gov/aa_whidbey.php). Massachusetts map of the nearshore ocean management planning area boundary is from the Massachusetts Office of Coastal Zone Management (http://www.mass.gov/czm/oceanmanagement/index.htm). Chesapeake Bay Map from Phillips et al., Discharge, Nitrate Load, and Residence Time of Ground Water in the Chesapeake Bay Watershed, (http://md.water.usgs.gov/publications/fs-150-99/html/index.htm).

While regional ocean governance programs explicitly strive for ecosystem health and sustainable use, they often fall short of their stated objectives. This can happen for a variety of reasons, including setting overly ambitious goals, lack of leadership to achieve objectives, inadequate funding, lack of a legal mandate to force implementation, and conflicting priorities or mandates, among others.

In part, the ability of regional ocean governance programs to achieve their goals depends upon the type of authority granted to the programs. In some instances, soft-law approaches like memorandums of understanding or letters of agreement form the basis of the program, leaving it up to existing sector-specific and environmental laws to create the legal and regulatory basis for action.[14] In other instances, regional programs are established under state law, by compact, or by treaty, and their authority is delineated in the founding legal document.[15] As a result, regional programs' abilities range from advisory to regulatory.[16]

Because of the various approaches to establishing regional ocean governance, this Handbook considers examples from all types and identifies advantages and limitations of each. It focuses on five key governance components of effective ecosystem-based management:

(1) Ecosystem-based plans to achieve conservation and sustainability objectives and guide governance decisions
(2) Scientific information to inform ecosystem-based plans and decisions
(3) Accountability of activities to existing ecosystem-based plans and programs
(4) Ability to address cumulative impacts over time, over space, and across sectors
(5) Ability to make tradeoffs within and across sectors

While existing legal authority may not enable full implementation of these EBM objectives, this Handbook identifies existing approaches to achieve ecosystem management. It includes examination of laws, regulations, and policies that can be used to take incremental steps in the direction of EBM, even absent a new legislative mandate. It also notes the limitations of these laws and institutional approaches for achieving EBM objectives and identifies key gaps that need to be filled in order to achieve a robust EBM framework at the state, regional, or national level.

The Handbook is divided into five Chapters, corresponding to the five governance challenges. Chapter II, Ecosystem Planning, identifies key science-based planning mechanisms and explores the ability to expand science-based planning across jurisdictions and sectors. Chapter III, Ecosystem Information, explores the legal and institutional options for science-based management through sector-specific laws, regional programs, and cross-cutting laws and policies. Chapter IV, Accountability, examines mechanisms for holding institutions accountable to ecosystem plans once they have been established. Chapter V, Cumulative Impacts, explores existing mechanisms to minimize cumulative impacts across time, space, and sectors. Finally, Chapter VI, Tradeoffs, builds on the previous chapters and explores how existing laws or soft-law approaches can help decision-makers balance competing ocean uses in practice.

14 Examples include West Coast Governors Agreement, Gulf of Mexico Alliance, and Chesapeake Bay Program.

15 Examples include California Ocean Protection Council, Puget Sound Partnership, International Joint Commission, Delaware River Compact, North Carolina Coastal Habitat Protection Plan, and Massachusetts Ocean Management Initiative.

16 Environmental Law Institute [hereinafter ELI], Ecosystem-Based Management: Laws and Institutions (2007) [hereinafter EBM: Laws and Institutions], *available at* http://www.eli.org.

C. Summary of Methods and Handbook Contents

ELI developed this Handbook to share different approaches to U.S. ocean and coastal EBM implementation,[17] focusing particularly on issues related to governance. The Handbook provides a spectrum of examples that take steps toward EBM. There are strengths and weaknesses in all approaches presented. The Handbook is not meant to provide the *one best* approach to achieving EBM. Instead, it is meant to provide examples that may be useful in different settings depending upon regional needs and implementation opportunities.

In each of the five main Chapters, there is a discussion of the general concept and its relationship to EBM, with a visual model outlining the contents of the Chapter. Each Chapter provides a suite of potential approaches for addressing the particular challenge, each of which is illustrated with concrete examples from existing regional ocean governance programs, as well as other regional governance programs and U.S. laws and policies. The potential approaches are meant to demonstrate how to achieve effective EBM governance.

The examples provided in this Handbook are largely drawn from state-based or multi-state approaches, and, in a few instances, small-scale EBM programs. Some sector-specific examples highlight sector-based implementation or demonstrate an EBM approach that could be applied in a broader cross-sector setting.

Many of the approaches in this Handbook represent examples of good governance that could and do apply in much broader contexts. For example, in the chapter focused on cumulative impacts, many examples stem from laws and policies beyond marine EBM. However, these general "good governance" approaches may be fundamental to the successful implementation of EBM, and are sometimes lacking in existing programs.

While most Handbook examples are documented in published or online materials, many of the ideas and some of the most insightful examples derive from the meetings and interviews that ELI has conducted and participated in during this project. In all, ELI co-hosted three regional stakeholder meetings with dozens of participants at each meeting. We conducted dozens of interviews to better understand the particular successes and challenges of existing EBM programs. ELI staff also participated in several EBM conferences and broader ocean and coastal meetings. Finally, this effort relied heavily on the expertise of ELI's EBM Working Group, which met three times over a two-year period. The Working Group provided a wealth of real-world experience and examples, which helped the authors conceptualize EBM governance and think critically about appropriate work products.

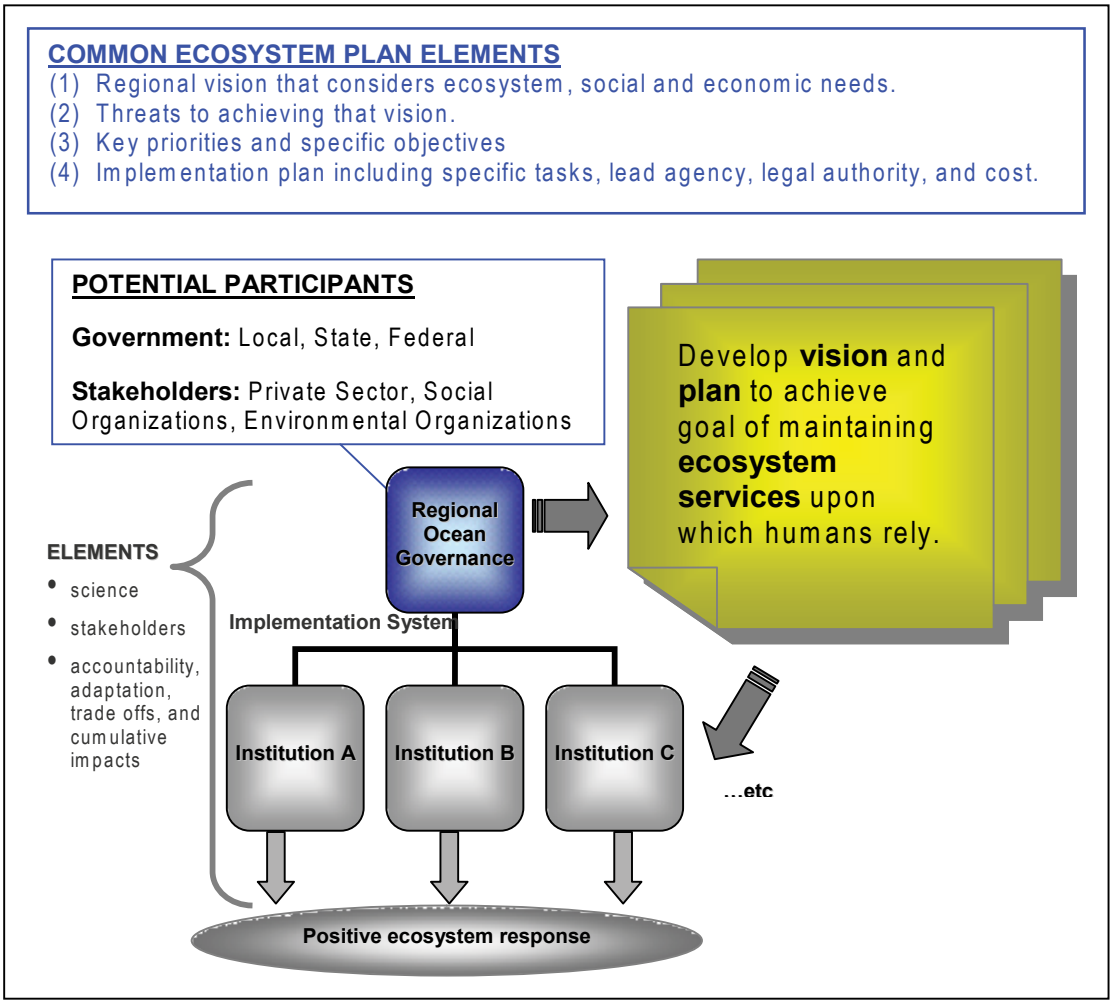
17 With this project, ELI specifically focused on U.S. ocean governance. We acknowledge that there is a wealth of examples from other developed and developing regions of the world, and that the approaches that are most useful in the U.S. may not work in other regions.

II. ECOSYSTEM-BASED VISION AND PLANNING

A. Vision and Planning In Brief

Central to ecosystem-based management is the need to develop a common vision of a healthy and resilient marine environment that considers the ecosystem, society, and the economy; and a plan of action to achieve that vision (Figure 7).

Figure 7: EBM Vision and Plan



To be EBM-focused, the regional vision should consider the needs of the ecosystem, society, and the economy. It should strive to maintain the full suite of ecosystem services upon which humans rely. From this vision, the region should collaboratively develop an implementation plan that prioritizes actions and has specific, tangible, and measurable objectives.

Several obstacles may prevent the development and implementation of a truly ecosystem-based plan. Many existing plans are not fully implemented due to lack of funding or lack of capacity to achieve objectives. From a legal and regulatory perspective, agency mandates or primary objectives may prevent the implementation of an ecosystem-based plan at the sector level. This could be exacerbated by the need to target limited resources toward accomplishing an agency's primary objectives. Lack of common interests across a region could limit the development and implementation of a comprehensive ecosystem-based plan. Several steps that can be taken to develop an implementation plan are discussed in this section.

Before delving into specific plan elements, this Chapter considers the procedural aspects of planning—namely the mechanisms and approaches used to develop the plan. Is plan development a public process or is it an internal process? Is it a plan based on consensus or is it a collection of different management strategies and ideas? Who participates in planning? This section first examines:

(1) Overall planning approaches.

- Consider drivers for program development.
- Include appropriate institutions and stakeholders.
- Use a strategic and adaptive process.

In addition to overall approaches, this chapter describes some common elements of ecosystem-based plans for the marine environment in more detail, including approaches that:

(2) Develop a regional vision.

- Develop a vision that considers ecosystem, social, and economic needs.
- Include specific target date to achieve overall vision.

(3) Conduct threats analysis.

- Describe specific threats and impacts that the regional plan and program will address.

(4) Identify concrete goals and measurable indicators.

- Use ecosystem assessments and threats analysis to inform development of concrete goals and measurable indicators.

- While working within a comprehensive EBM approach, keep concrete goals focused on key priorities.
- Include specific indicators to measure success.

(5) Develop an implementation plan.

- Designate a lead agency.
- Identify the legal authority to act.
- Estimate implementation cost, funding sources, and cost of inaction.

B. Vision and Planning In Practice

1. Overall Planning Approaches

1.1. Consider drivers for program development.

Rationale: Many interviewees and meeting participants have commented that EBM should respond to a specific need. In practice, the drivers for program development are often resource degradation and the need to restore ecosystem damage. In some places, however, state governments are working toward maintaining or enhancing ocean ecosystems and have passed laws to help plan for and manage new and expanding ocean uses. In both situations, achieving EBM is not a goal in itself. The goal is to use this science-based collaborative approach to achieve the objectives of maintaining, enhancing, or restoring ecosystem function in the face of existing and new ocean uses.

Example: Degraded Ecosystems—Chesapeake Bay Program and Puget Sound Partnership

In 1979, Congress funded $27 million worth of research focused on understanding Chesapeake Bay degradation. Established in 1983, the Chesapeake Bay Program responded to the scientific findings of a five-year study with the creation of the first regional agreement for the Bay.[18] In the *1983 Chesapeake Bay Agreement*, EPA, Maryland, Pennsylvania, Virginia, and the District of Columbia agreed to collaborate to restore the water quality and living resources of the Bay,

18 Chesapeake Bay Program, *History of the Bay Program*¸ *at* http://www.chesapeakebay.net/historyofcbp.aspx?menuitem=14904.

recognizing that the complexity of the problem required a joint solution.[19] The Agreement established an Executive Council tasked with assessing and overseeing the implementation of coordinated plans.[20]

A more recent restoration-based program is the Puget Sound Partnership. Its goal is "is to make Puget Sound healthy again, and create a roadmap for how to get it done."[21] Washington Governor Gregoire established the first Puget Sound Partnership in 2005, tasking it to "develop recommendations for preserving the health and ecosystem of Puget Sound, and to help educate and enlist the public in achieving recovery of the Sound by 2020."[22] After the release of the recommendations report, the state legislature passed a law establishing a permanent Partnership charged with restoring the Sound by 2020.

Example: Legislative Opportunity or Mandate—California Ocean Protection Council

California lawmakers passed the California Ocean Protection Act in 2004, establishing the California Ocean Protection Council.[23] The Council is tasked with coordinating state activities related to conservation and protection of ocean resources.[24] While restoration is included among the objectives, the language of the law focuses more on forward-looking coordinated and integrated management approaches rather than creating a management system to correct past ecosystem impacts.

19 1983 Chesapeake Bay Agreement, *available at* http://www.chesapeakebay.net/historyofcbp.aspx?menuitem=14904.

20 *Id.*

21 Puget Sound Partnership, *About the Partnership*, *at* http://www.psp.wa.gov/aboutthepartnership.php.

22 Puget Sound Partnership, Sound Health, Sound Future: Protecting and Restoring Puget Sound (2006), *available at* http://www.pspar-chives.com/publications/about_us/psi_reports/final/final/Final_wAPPx_lr.pdf.

23 Cal Pub. Res. Code § 35500 et seq. (2004).

24 § 35615(a)(1).

1.2. Include appropriate institutions and stakeholders.

Rationale: The planning process must include the appropriate regional institutions and stakeholders in order to develop a legitimate process and create a plan that can address the important regional challenges by tapping the participants' expertise and resources. The specific institutions and stakeholders will vary by region, but often include ocean-related natural resource agencies, ocean-related ocean regulatory agencies, and the stakeholder they regulate. Less often seen in practice but expressed as a need is the inclusion of less-obvious participants whose activities affect the ocean such as the transportation sector and the agricultural sector. Limitations to broad inclusion include the difficulty in making consensus-based decisions as the diversity and number of participants expands; the challenge of finding a site that can host a large number of participants; and the difficulty of scheduling meetings to accommodate this large number of participants. In practice, existing regional governance programs often create small leading bodies with more diverse and larger subcommittees to inform the decision-making of the leading body.[25]

Example: Planning with Experts and Stakeholders—Puget Sound Partnership

In the development of its 2020 Action Agenda, the Puget Sound Partnership (Partnership) took an inclusive approach to the planning process that maximized the use of available expertise and addressed a broad range of stakeholder input. The Partnership posed questions to scientists, elected officials, businesses, and local communities. It held topical forums with regional experts and implementer-focused action meetings that concentrated on specific challenges and top priorities.[26] The Partnership engaged its Science Panel and Ecosystem Coordination Board when reviewing input received and when refining the plan. By consulting the Board and the Panel, the Partnership included the ideas of individuals from the state legislature, businesses, environmental organizations, tribal governments, counties, cities, and port districts, state agencies with environmental management responsibilities in Puget Sound, federal agencies with responsibilities in Puget Sound, and scientists.

Example: Planning with Experts and Stakeholders—Massachusetts Oceans Act

In the development of its integrated ocean management plan, Massachusetts is engaging a range of institutions and stakeholders in the planning process. While the state's Secretary of Energy and Environmental Affairs oversees and coordinates the planning process, the Secretary must incorporate the input of the Ocean Advisory Commission and the Ocean Science Advisory

25 A description of the types of participants in existing regional programs can be found in ELI, EBM: LAWS AND INSTITUTIONS, supra note 16.

26 Puget Sound Partnership, Puget Sound Action Agenda [hereinafter Partnership Action Agenda] 3 (December 2008), available at http://www.psp.wa.gov/downloads/ACTION_AGENDA_2008/Action_Agenda.pdf (accessed January 13, 2009).

Council.[27] By consulting both the Commission and the Council, the Secretary incorporates the ideas of individuals from the state legislature, the Office of Coastal Zone Management, the Division of Marine Fisheries, the Department of Environmental Protection, regional planning areas, the scientific community, and commercial fishing, environmental, and offshore renewable energy interest groups.[28] In addition, the Joint Committee on State Administration and Regulatory Oversight and the Joint Committee on Environment, Natural Resources, and Agriculture may review the proposed ocean plan.[29]

1.3. Use a strategic and adaptive process.

Rationale: To design an effective plan that will achieve outcomes that support healthy and resilient ecosystems, a strategic planning process is essential. Also, it is well recognized that plans should adapt as knowledge, conditions, and circumstances change.

Example: The Nature Conservancy Conservation Approach and 5-S Approach

The Nature Conservancy (TNC) conservation approach is a four-step cyclical process: (1) set priorities through ecoregional planning and assessment; (2) develop strategies at multiple scales to address priorities and threats; (3) take action; and (4) measure success.[30] In specific areas, TNC uses its "5-S Framework for Conservation Project Management." The 5-S approach includes: (1) **systems**, focal conservation targets and key ecological attributes; (2) **stresses**, major types of impacts on targets and attributes; (3) **source of stress**, the agents causing stresses; (4) **strategies**, full array of actions needed to address the source of stress; and (5) **success measures**, the monitoring process for assessing progress toward abatement of stresses.

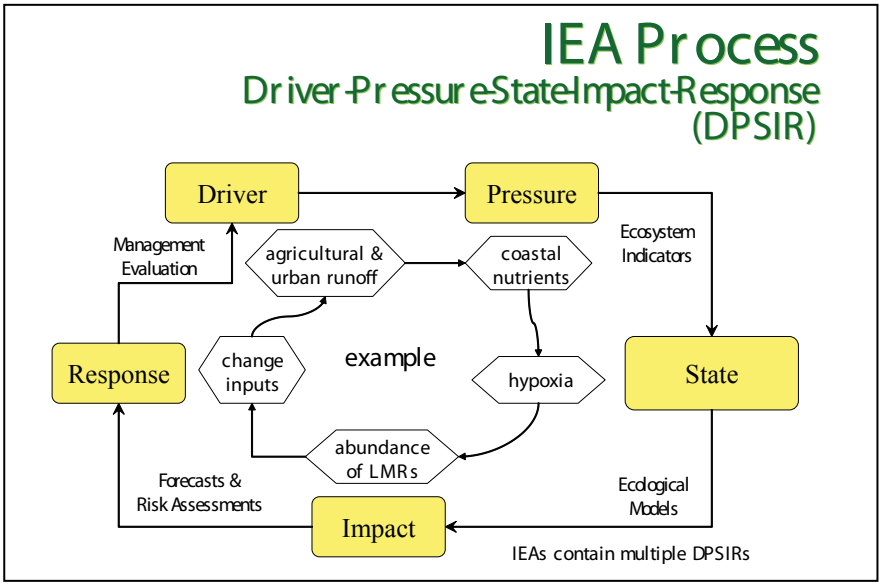
Example: An Analytical Framework—NOAA Integrated Ecosystem Assessment

NOAA is developing pilot Integrated Ecosystem Assessments (IEAs) in several U.S. regions. According to its creators, "[a]n IEA is a formal synthesis and quantitative analysis of information on relevant natural and socioeconomic factors relative to specified ecosystem management goals."[31] The IEA process involves five considerations: (1) drivers of ecosystem change, (2) pressures on the ecosystem caused by the drivers, (3) the state of the ecosystem as a result of

27 Mass. Gen Law ch. 21A § 4C (a) (2008).
28 § 4C (a)-(d).
29 § 4C (i).
30 The Nature Conservancy, Conservation by Design: A Framework for Mission Success (2004), *available at* http://www.nature.org/aboutus/howwework/files/cbd_en.pdf.
31 Phillip S. Levin, Michael J. Fogarty, Gary C. Matlock, & Marjorie Ernst, *Integrated Ecosystem Assessments*, NOAA Technical Memorandum NMFS-NWFSC-92 (2008), http://www.nwfsc.noaa.gov/assets/25/6801_07302008_144647_IEA_TM92Final.pdf (includes key published examples of IEA implementation).

the pressures, (4) the impact of the state of the ecosystem, and (5) the management response (Figure 8).[32] The process should be iterative and result in management evaluation, which will feedback and inform a new process of driver→ pressure→ state → impact → response. Included in the IEA should be a characterization of target levels and thresholds for important ecosystem components.[33]

Figure 8. IEA Process[34]



Example: Deliberations and Consensus—Chesapeake Bay Fishery Ecosystem Plan

The Chesapeake Bay Fishery Ecosystem Plan (FEP) is a sector-specific approach, but one that could be adapted to a broader EBM context. The FEP is a consensus document developed in response to the recommendations made by the NMFS Ecosystem Principles Advisory Panel, which was established in response to a request from Congress.[35] The plan is a product of the Ecosystem Plan Technical Advisory Panel deliberations and consensus. NOAA and the Chesapeake Bay Program hosted a regional workshop to formulate the strategy and guidelines for plan development.[36]

32 *Id.*
33 *Id.*
34 Steven Murawski & Emily Menashes, What is an Integrated Ecosystem Assessment? (PowerPoint presentation, Mar 2007), *available at www.gulfofmaine.org/ebm/meeting2007/presentations/noaa_murawski_files/noaa_murawski.ppt.* Reprinted with permission from Steven Murawski.
35 THE CHESAPEAKE FISHERIES ECOSYSTEM PLAN TECHNICAL ADVISORY PANEL, FISHERIES ECOSYSTEM PLANNING FOR CHESAPEAKE BAY ix, 4 (2006) [hereinafter CHESAPEAKE FISHERIES ECOSYSTEM PLAN].
36 *Id.* at xii.

The developers of the plan represent the following institutions: federal institutions (NOAA Chesapeake Bay Office, U.S. Environmental Protection Agency), multi-state institutions (Atlantic States Marine Fisheries Commission), a state institution (Maryland Department of Natural Resources), and academic institutions (University of Maryland Center for Environmental Science, Virginia Institute of Marine Science, Academy of Natural Sciences). Further support came from the Chesapeake Bay Fisheries Steering Committee and several regional experts.

Example: Consensus-Based Approach—North Carolina Coastal Habitat Conservation Plan

North Carolina utilizes a consensus-based, strategic approach to developing the North Carolina Coastal Habitat Protection Plan (CHPP). Development of the plan requires coordination among the state agencies responsible for fisheries management, coastal zone management, and water-quality management.[37] The state's Marine Fisheries Commission creates the initial draft of the CHPP. The chairs of the three state agencies involved in the planning process— the Marine Fisheries Commission, the Coastal Resources Commission, and the Environmental Management Commission— then each appoint two commission members to a review committee.[38] The six-member committee reviews and revises the draft plan based on consensus.[39] Each Commission then examines the draft, and any disagreements are resolved through the creation of a six-member conference committee.[40] The result is the development of a plan based on consensus among the three state agencies. Through an adaptive process, the agencies review and revise the CHPP every five years.[41]

2. Develop a Regional Vision

2.1. Develop a vision that considers ecosystem, social, and economic needs.

Rationale: An EBM vision should be the result of agreed common goals and strategies of the region including both government institutions and stakeholders. The vision should help guide the overall program toward an ecosystem-based approach that recognizes the important intersection between ecosystem, social, and economic needs. Expressing an explicit vision should help EBM programs focus as they develop and implement plans.

37 North Carolina Fisheries Reform Act, § 143B-279.8(a) (1997).
38 § 143B-279.8(b).
39 § 143B-279.8(b).
40 § 143B-279.8(b).
41 § 143B-279.8(b).

If the Plan is developed pursuant to a legal mandate, the mandate may specify the plan vision and the other elements of the plan. Table 2 provides examples of plans developed in accordance with a legal mandate, as well as those developed in the absence of one.

Table 2. Examples of Regional Visions

Program	Vision in Plan or Founding Document
Gulf of Maine Council on the Marine Environment	In its current 5-year plan, The Gulf of Maine Council expresses the following long-term goals: "Goal 1 Coastal and marine habitats are in a healthy, productive, and resilient condition. Goal 2 Environmental conditions in the Gulf of Maine support ecosystem and human health. Goal 3 Gulf of Maine coastal communities are vibrant and have marine-dependent industries that are healthy and globally competitive."
California Ocean Protection Council	The COPC's Strategic Plan includes a two-page vision statement that identifies "what success might look like." The vision describes an environment that is "clean, safe, prospering, and sustainably managed." It includes a vision of management that is ecosystem-based, relies on the precautionary, principle, and is adaptive. It describes a management approach based on sound science and policies that lead to better education.
Gulf of Mexico Alliance	As stated in its Action Plan, the Gulf of Mexico Alliance is "intent on significantly increasing regional collaboration to enhance the ecological and economic health of the Gulf of Mexico."
West Coast Governors Agreement on Ocean Health	The West Coast Governors Action Plan, it describes a vision of a healthy ocean: "In this plan, a "healthy ocean" means that marine, coastal, and estuarine ecosystems, the watersheds that drain into these waters, the plant and animal communities therein, and the physical, chemical, and biological processes involved are diverse and functioning, and the economies and people dependent on them are thriving. A healthy ocean provides aesthetic, cultural, and recreational values. It also supports the character and quality of life of coastal communities and a vibrant, sustainable economy. Acknowledging that isolated efforts cannot address the breadth of degradation to the ocean, the states are committed to working together to address critical protection and management issues faced by all three states. By combining resources, the three states will affect positive change in the present state of ocean health."

Program	Vision in Plan or Founding Document
Puget Sound Partnership	The Puget Sound Partnership is in the process of developing its Action Agenda. The initial outline envisions a healthy ocean. The Partnership states that the section will articulate the goals of the Partnership. "It will describe what a healthy Puget Sound is and the key measures and targets we will use to assess our progress toward Puget Sound recovery." The Puget Sound Partnership Action Agenda defines a healthy Puget Sound as "a thriving natural world, high quality of life for people, and a vibrant economy."[42] The Action Agenda envisions a healthy ecosystem as comprising three important properties: resiliency to changes caused by humans or natural events; redundancy, or the presence of species and habitats in more than a single location; and a historically representative sample of species and habitats.[43] The comprehensive vision is also tied to strategic priorities and desired outcomes.
Aleutian Islands Fishery Ecosystem Plan	As stated in the *Overview of the Aleutian Islands Fishery Ecosystem Plan*, "[t]he goal of this FEP is to provide enhanced scientific information and measurable indicators to evaluate and promote ecosystem health, sustainable fisheries, and vibrant communities in the Aleutian Islands region." While sector-specific, the vision includes consideration of the ecosystem, economy (fisheries), and society (vibrant communities). The Ecosystem Committee of the Council[44] determined the goal of this FEP collaboratively with both the Council and the FEP team, a group of experts who ultimately wrote the FEP.[45]
Chesapeake Bay Fishery Ecosystem Plan	The NMFS Ecosystem Principles Advisory Panel established the FEP goal of "an umbrella document containing information on the structure and function of the ecosystem in which fishing activities occur, so that managers can be aware of the effects their decisions have on the ecosystem, and the effects other components of the ecosystem have on its fisheries."[46] In response to this goal, the FEP Technical Advisory Panel created a vision with seven guiding principles.

42 Partnership Action Agenda, *supra* note 26 at 8.

43 *Id.* at 12.

44 The Ecosystem Committee was composed of the chair of the Council, a representative of the Marine Conservation Alliance, the head of Oceana, the head of EPA Region 8, a professor at UW, and the head of the Alaska Fishery Science Center.

45 Personal communication, on file with authors (Jan. 13, 2009).

46 Chesapeake Fisheries Ecosystem Plan, *supra* note 35 at 4.

2.2. Include specific target date to achieve overall vision.

Rationale: Part of the challenge of building accountability into the regional ocean governance program, setting a specific date for achieving the vision helps create concrete goals and objectives. Timelines offer an accountability mechanism that could entail either a legal or non-legal approach. Deadlines establish a standardized way to gauge progress, and thus provide an opportunity to increase accountability. Timelines can be adaptive in order to address existing needs and reflect lessons learned.

Example: Agreement-Based Target Dates—Chesapeake Bay Program and Gulf of Maine Council on the Marine Environment

The Chesapeake Bay Program provides an example of a voluntary approach to deadlines. "Chesapeake 2000" outlines goals in five areas: living resources, vital habitat, water quality, land use, and stewardship and community engagement. Many goals in these five areas have set deadlines.

The Gulf of Maine Council on the Marine Environment (Gulf of Maine Council) establishes long-term goals of protecting and restoring habitats, fostering environmental and human health, and supporting vibrant communities, and creates a five-year action plan to move closer toward achieving these goals.[47] This is the fourth action plan for the Gulf of Maine Council—a program established in 1989.

Example: Mandated Target Date—Puget Sound Partnership

The Puget Sound Partnership has the explicit goal of achieving a "healthy Puget Sound" by 2020. According to the state law, the Partnership is to develop an action agenda "based on science and include[ing] clear, measurable goals for the recovery of Puget Sound by 2020."[48]

47 Gulf of Maine Council on the Marine Environment, Action Plan 2007-2012 (2007), *at* http://www.gulfofmaine.org/actionplan/.
48 Engrossed Substitute Senate Bill 5372 [hereinafter ESSB 5372], § 1 (Wash. 2007).

3. Conduct Threats Analysis

3.1. Describe specific threats and impacts that the regional plan and program will address.

Rationale: ELI's research indicated that one of the elements needed to achieve EBM implementation was a demonstration that the EBM approach will solve specific problems facing the region. EBM is a process to achieve a certain result; thus, EBM should not be undertaken simply for the sake of "doing EBM."

Example: Frameworks and Strategies—The Nature Conservancy 5-S Framework for Conservation Project Management and NOAA Integrated Ecosystem Assessment

As described in the previous section on overall planning processes, The Nature Conservancy's approach to conservation planning offers useful insights. As part of its 5-S framework, it includes identifying the stresses on the system and the sources of stress. These can collectively be considered the challenges that the program and plan will seek to address.

Described previously, NOAA's Integrated Ecosystem Assessment is a process for supporting EBM. At the outset is a determination of the driver, pressure, and state of the ecosystem. Figure 9 uses the examples of agricultural runoff as the driver, coastal nutrients as the pressure, and hypoxia as the state of the ecosystem.

Example: Regional Program Approaches—Gulf of Maine Council on the Marine Environment and Gulf of Mexico Alliance

The Gulf of Maine Council focuses its specific actions on goals that demonstrate success. For example, the first goal is to protect and restore habitats. In the Council's description of the specific action items, it briefly describes the problems. For example, under the first goal, the Plan states:

> This goal focuses on four related issues that affect the health of the Gulf of Maine, its watershed, and the marine economic sector.
> a. Invasive Species. Non-native plants and animals pose a major threat to the ecosystem and economic uses of the Gulf.
> b. Land-based Activities. Human activities on land can lead directly or indirectly to degradation of the Gulf of Maine. …[49]

49 *Id.* at 2.

In its Action Plan, the Gulf of Mexico Alliance identifies five goals: water quality, wetland restoration; environmental education; characterization of Gulf habitats; and reductions in nutrient inputs. Prior to describing specific actions, the Plan briefly summarizes the specific challenge and discusses how the Alliance can help. While not explicitly stated in the plan, the Alliance presumably considered the ecosystem threats and prioritized actions based on those threats in the course of developing the plan. However, some key threats, such as nutrient-loading from upstream states, are not addressed by the plan.

4. Identify Concrete Goals and Measurable Indicators

4.1. Use ecosystem assessments and threats analysis to inform development of concrete goals and measurable indicators.

Rationale: An important part of EBM is the development of strategies to achieve healthy and resilient ecosystems. This means that plan concrete goals and measurable indicators of success should be based on an understanding of the ecosystem and the threats to that system. The threats assessment should help guide the next phase of plan development—i.e. help determine what actions are necessary to minimize critical threats to the health and resilience of the ecosystem. Several adaptive management models take this type of approach. For example, the TNC 5-S program and NOAA IEA are two iterative strategies that consider threats and develop actions according to the threats (see previous section for description of TNC and NOAA approaches).

Example: Sector-Specific Approach—Aleutian Islands Fishery Ecosystem Plan

The Aleutian Islands Fishery Ecosystem Plan (AIFEP) uses expert opinion to assess ecosystem risks and to establish plan priorities. After identifying 22 key interactions (including climate and physical, predator-prey, fishing effects, regulatory, and other socio-economic activity interactions) that occur within the Aleutian Islands ecosystem, the plan determines each interaction's level of impact and likelihood of occurrence. For example, the Plan identifies increased acidification due to climate change as a high priority based on its potential level of impact and the likelihood of it occurring.[50] Based on these assessments, the plan assigns each key interaction a risk assessment priority level. The plan utilizes this assessment to evaluate the North Pacific Fishery Management Council's current efforts to address these risks, and how the Council could respond in the future.[51]

50 Aleutian Islands Ecosystem Team, Aleutian Islands Fishery Ecosystem Plan, 20, *available at* http://www.fakr.noaa.gov/npfmc/current_issues/ecosystem/AIFEPbrochure1207.pdf.
51 *Id.* at 18-20.

Example: Cross-Sector Regional Approach—Puget Sound Action Agenda

When developing the priorities of the Puget Sound Action Agenda, the Puget Sound Partnership drew upon three ongoing efforts to assess the threats to the Sound. At the regional level, the Agenda utilized data generated by NOAA and the National Marine Fisheries Service as a part of an Integrated Ecosystem Assessment of Puget Sound. PSP also engaged scientific and policy experts to evaluate threats to a healthy Sound. By discussing major constraints with local implementers from the seven Puget Sound action areas, threats at the local level also shaped the Agenda's priorities and objectives.[52] Thus, these three threat analyses informed the development of the Action Agenda's priorities: (1) protect intact ecosystem processes, structures, and functions; (2) restore ecosystem processes, structures, and functions; (3) prevent water pollution at its source; (4) coordinate work on priority actions; and (5) build an implementation, monitoring, and accountability management system.[53]

4.2. While working within a comprehensive EBM approach, keep concrete goals focused on key priorities.

Rationale: In all regions, whatever their scale, there is likely to be a long list of potential social, economic, and environmental challenges. This means that the planning document could identify an enormous list of activities as part of its comprehensive approach. However, a plan that tries to achieve too many objectives at once may have trouble achieving any of them and demonstrating success. ELI's research suggests that EBM programs should focus on issues that are best solved through regional collaboration, rather than attempting to make all issues regional.

Example: Broad Goals to Annual Targets—Chesapeake Bay Program

Chesapeake 2000 outlines 102 restoration commitments that fall within five broad goals. The list of objectives is ambitious, and in some cases the Chesapeake Bay Program established restoration goals that it could not realistically achieve given the available resources.[54] In response to GAO's 2005 assessment and the Consolidated Appropriations Act of 2008, the Chesapeake Bay Program revised its implementation goals in order to better account for limited resources. The Chesapeake Bay Program partners developed 16 realistic annual targets, taking into consideration both historic and existing program progress and funding.[55] The 16 targets

52 Partnership Action Agenda, *supra* note 26 at 28.

53 *Id.* at 29-30.

54 U.S. Gen. Acct. Off. [hereinafter GAO], Chesapeake Bay Program: Improved Strategies Are Needed to Better Assess, Report, and Manage Restoration Progress, Doc No. 06-96, at 6 (2005), available at http://www.gao.gov/new.items/d0696.pdf.

55 U.S. Environmental Protection Agency [hereinafter EPA], Region 3, Strengthening the Management, Coordination, and Accountability of the Chesapeake Bay Program 14, *available at* http://cap.chesapeakebay.net/docs/EPA_Chesapeake_Bay_CAP.pdf.

include three Bay-wide measures supported by all topic areas, and reflect achievable objectives given the program's current resources and initiatives.

Example: Attainable Goal-Setting—Gulf of Mexico Alliance

ELI learned through interviews that the Gulf of Mexico Alliance intentionally limited priorities to those issues that were regional in nature and could be addressed by the five coastal states that made up the Alliance. One of the goals in taking this approach was to demonstrate success with this initiative by working on a smaller number of attainable goals. For example, the Action Plan lists harmful algal blooms that impair a wide range of coastal activities. To tie this problem to the Alliance solution, it states "The five Gulf States face similar water quality problems in many critical and shared watersheds and can recognize the value of a collaborative regional approach to address these issues. A better scientific understanding of problems, as well as shared successes, will result in cost-savings and more effective management."[56]

4.3. Include specific indicators to measure success.

Rationale: Defining specific indicators (also described as "reference points, directions or surfaces, thresholds, limits, targets, etc.")[57] to measure success enables adaptive management and creates a mechanism for the EBM program and its stakeholders to evaluate whether the program is accomplishing its goals. Indicators often focus on the health of the ecosystem or components of the ecosystem as well as society, economy, and the management process. Indicators can be qualitative or quantitative. To be effective, indicators should inform management action—actions which should be linked to the overall ecosystem goals. Sector-based management provides examples. A comprehensive set of marine ecosystem-based management indicators has yet to be developed. However, scientists and managers are moving in the direction of indicators that support ecosystem-based management.[8]

56 Gulf of Mexico Alliance, Governors' Action Plan for Healthy and Resilient Coasts 12 (2006).

57 Jason S. Link, *Translating Ecosystem Indicators into Decision Criteria*, 62 ICES J. Marine Sci. 569 (2005). To move beyond single-species fisheries management for example, Link (2005) identifies fourteen indicators that relate to length of all species, size spectrum of all species, biomass of flatfish, pelagic species, high trophic level species, and piscivores, landings of target species, interactions per species, fishery removals of all species, species richness, number of cycles, abundance of scavengers, volume of gelatinous zooplankton, and area of live, hard corals

58 *Id.* at 570.

Example: Fisheries Indicators—Chesapeake Bay[59]

In the 1980s, the surrounding states and relevant agencies formed a partnership to protect and restore the Chesapeake Bay ecosystem. The Chesapeake Bay Program issued a reaffirmation of its commitment and restatement of its objectives in 2000. Among the stated goals, the partnership pledged to restore and preserve the finfish and other living resources within the bay, including their habitats and relationships. The goal was divided into more specific targets: through 2003 they focused on single species restoration efforts, then beginning in 2004 emphasized multi-species management. By 2005 there were to be "ecosystem-based multi-species management plans for targeted species," followed by efforts to "revise and implement existing fisheries management plans to incorporate ecological, social and economic considerations, multi-species fisheries management and ecosystem approaches" by 2007.[60]

In practice, however, the transition from single-species to multi-species management could not be accomplished instantaneously. Indicators of overall ecosystem health could not be immediately implemented. Thus the Program developed two sets of goals and indicators by which to assess progress in fisheries management towards an ecosystem-based approach. The first set encompassed the actual health of the fisheries, based on individual targets set for each of five key fishery species – for example, increasing the level of spawning biomass of blue crab, increasing the overall biomass of native oysters, or achieving a desirable catch per unit effort for shad.[61]

The second set of goals and indicators uses the results of the health-based indicators, but focuses on monitoring framework progress towards ecosystem-based fisheries management (EBFM), based on whether the individual fishery management frameworks incorporated multi-species and/or ecosystem-wide considerations. To make the assessments easy to compare and track, an index was established that divides the management framework into three phases of development: (i) single-species fisheries management (SSFM), (ii) SSFM with multi-species management consideration, and (iii) EBFM. An individual fishery management framework can earn a maximum number of points within each stage, and then the points from each stage are summed for a total score of up to 100 points. The scoring system makes it possible to directly compare each fishery's progress towards EBFM, while the subdivided categories simultaneously show the overall health of the individual fisheries.[62] For example, even though in 2007 the Striped Bass

59 Resources for fisheries indicators include Stephen Jordan & Edward Houde, *Managed fisheries of the Chesapeake Bay*, *in* Chesapeake Fisheries Ecosystem Plan, *supra* note 35 at 237–51 (containing explanations and examples of fisheries ecosystem assessment tools and indicators for fisheries).

60 Chesapeake Bay Program, Chesapeake 2000 (June 28, 2000).

61 *Id.*; Chesapeake Bay Program, Health Assessment Indicator Goals, *available at* http://archive.chesapeakebay.net/status/status07/IndicatorGoalsHealthAssessment.doc; Chesapeake Bay Program, Replacement Indicator Information: Shad Abundance Indicator for the Chesapeake Bay (Jan. 24, 2008), *available at* http://archive.chesapeakebay.net/pubs/calendar/MONSC_12-18-07_Handout_9_9244.pdf.

62 *See* Robert J. Wood & Ben J. Longstaff, *Tracking Progress Towards Ecosystem Based Fisheries Management*, Proceedings of Coastal Zone 07, July 22-26, 2007 (Portland, Oregon), *available at* http://www.csc.noaa.gov/cz/2007/Coastal_Zone_07_Pro-

spawning biomass was at 100 percent of its target level, its overall score was 63 points because it had not yet achieved EBFM.[63]

Example: Water Quality Indicators—Everglades[64]

In the late 1990s, the Army Corps of Engineers undertook the design and development of a new plan to protect and restore the Florida Everglades. The restudy, issued in 1999, contained a recommended comprehensive restoration plan that was adopted in the Water Resources Development Act of 2000—the resulting project has been referred to as the world's largest ecosystem restoration effort.[65] An integral part of the plan to restore the Everglades is restoring regional water quality conditions. To achieve this, one of the plan's recommendations was to establish numeric water quality criteria for the various waterbodies. If initial monitoring efforts focused on establishing baseline data, then the criteria would provide concrete restoration goals and a method for assessing progress.[66]

In general, the comprehensive plan uses performance measures and periodic interim goals to gauge the progress of restoration efforts. For instance, consider the goal of restoring water quality in one of the primary waterbodies in the Everglades, Lake Okeechobee. The ecology of Lake Okeechobee is detrimentally affected by excessive blue-green algal blooms and unnaturally fluctuating water levels.[67] Therefore two of the lake's performance measures are (1) decreasing phosphorous concentrations from initial concentrations of over 100ppb to a concentration of just 40ppb,[68] and (2) eliminating extreme water level events of over 17 or less than 10 feet while keeping seasonal water level variation between 12.5-15.5 feet.[69] With these numerical goals in place, the recommended interim goals were easily defined as decreased levels of phosphorous

ceedings/PDFs/Tuesday_Abstracts/3542.Wood.pdf; *see also* Chesapeake Bay Program, 2008 Fisheries Management Effort Index, Data file, *available at* http://archive.chesapeakebay.net/status/status08/fisheriesmanagementindex2008.xls.

63 *See* Chesapeake Bay Program, 2008 Fisheries Management Effort Index, *supra* note 62; Chesapeake Bay Program, 2007 Health and Restoration Assessment, CBP/TRS-291-08, EPA-903-R-08-002 (Mar. 2008), *available at* http://www.chesapeakebay.net/content/publications/cbp_26038.pdf.

64 Resources for water quality indicators include EPA, National Coastal Conditions Report III (Dec. 2008) (providing indicators for water quality, sediment quality, benthic conditions, coastal habitat conditions, and fish tissue contamination); Robert F. Doren, Joel C. Trexler, Andrew D. Gottlieb, & Matthew C. Harwell, *Ecological indicators for system-wide assessment of the greater everglades ecosystem restoration program* (2008) (providing a list of criteria to use when determining indicator applicability. The article is focused on the Everglades but the criteria are useful in other contexts).

65 U.S. Army Corps of Engineers, Central and Southern Florida Project Comprehensive Review Study, Final Integrated Feasibility Report and Programmatic Impact Statement (PEIS) (1999), *available at* http://www.evergladesplan.org/pub/restudy_eis.aspx#mainreport [hereinafter Comprehensive Everglades Restoration Plan (CERP)]; Water Resources Development Act of 2000, P.L. 106-541 (Dec. 11, 2000).

66 *See* CERP, *surpa* note 65 at § 9.48.

67 CERP, Restoration Coordination and Verification (RECOVER), The Recover Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan ii (Feb. 17, 2005) [hereinafter RECOVER Recommendations].

68 CERP, System-wide Performance Measure Documentation Sheet, Lake Okeechobee Performance Measure—Lake Stage (Mar. 7, 2007).

69 CERP, System-wide Performance Measure Documentation Sheet, Lake Okeechobee Performance Measure—Water Quality Mosaic (Mar. 8, 2007).

and decreased occurrences of harmful high and low water levels – e.g., lake levels above 17 feet were expected to decline 50 percent by 2015.[70]

Example: Land Use Indicators—Gulf of Maine Council on the Marine Environment

To achieve its broad restoration and protection goals, the Council has a program addressing mitigation of coastal development impacts. The short-term objective is to increase coastal lawmakers' understanding of how to reduce the coastal environmental impacts of land-based activities. The mid-term goal is to enact legislation requiring such impact minimization, improve local planning tools to achieve such reductions, and get private entities to likewise minimize their impacts. The long-term goal is to minimize the impact of coastal activities on the overall environment.[71] The Council's eighteen-month Work Plan then delineates specific tasks for achieving these outcomes.[72] Simultaneously, the Ecosystem Indicator Partnership is working on developing indicators for ecosystem monitoring – as relevant to land-based activities, it is establishing coastal development indicators for point sources, employment density, population density, and impervious surfaces.[73]

Example: Management Indicators—MPA Guidebook

The MPA guidebook, *How is Your MPA Doing?: A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness*, provides a step-by-step process for selecting indicators, planning evaluation, conducting evaluation, and communicating results and adapting management.[74] While focused on marine protected areas specifically, this approach may be useful in a broader marine EBM context. The process for selecting indicators includes: (1) identifying MPA goals and objectives; (2) matching relevant indicators to MPA goals and objectives; (3) reviewing and prioritizing the indicators; (4) possibly prioritizing a subset of indicators if all are not feasible; and (5) identifying connections among indicators.[75] It includes a list of biophysical indicators such as species abundance, population structure, habitat distribution and complexity, and food web integrity.[76] Socioeconomic indicators include local marine resource use patterns, values and beliefs about marine resources, quality of human health,

70 RECOVER Recommendations, *supra* note 67 at 17-26; Intergovernmental Agreement Among the U.S. Dep't of the Army, U.S. Dep't of the Interior, and the State of Florida Establishing Interim Restoration Goals for the Comprehensive Everglades Restoration Plan (Mar. 2, 2007).

71 Gulf of Maine Council on the Marine Environment, Action Plan 2007-2012, *supra* note 47.

72 Gulf of Maine Council on the Marine Environment, Work Plan January 2007 to July 2008 (Dec. 2006), available at http://www.gulfofmaine.org/actionplan/Jan07-Jun08%20Work%20Plan%20Final.pdf.

73 Gulf of Maine Council on the Marine Environment, EcoSystem Indicator Partnership (ESIP), *Primary Indicators*, http://www.gulfofmaine.org/esip/index.php#Primary%20Indicators.

74 Robert S. Pomeroy, John E. Parks, & Lani M. Watson, How is Your MPA Doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Areas Management Effectiveness (2004).

75 *Id.* at 8.

76 *Id.* at 52-53.

number and nature of markets, and percentage of stakeholder group in leadership positions.[77] Governance indicators include existence of a decision-making and management body, local understanding of MPA rules and regulations, the level of training provided to stakeholders in participation, and clearly defined enforcement procedures.[78] In all instances, indicators are linked to overarching management goals and specific objectives.

5. Develop an Implementation Plan

5.1. Designate a lead agency.

Rationale: In many voluntary regional programs that lack explicit implementation mandates, the specific institution tasked with taking action may not be apparent. Especially when a legal mandate is lacking, designation of a lead agency may enhance accountability and encourage plan implementation. Not only is the agency on notice of its role, but stakeholders and the broader public will have information about the party responsible for action.

Example: Activities Matrix—Gulf of Mexico Alliance

In its Implementation Activities Matrix, the Gulf of Mexico Alliance lists the lead agency, contributors, and collaborators for all specific actions.[79] The lead agency is responsible for accomplishing the particular activity. The contributors have agreed to provide funding or in-kind support to accomplish the activity, and the collaborators must be included in the decision-making process for the particular activity.

Example: List of Actions and Institutions—California Ocean Protection Council

In its first strategic plan, the Ocean Protection Council (OPC) includes an appendix, "Detailed List of Actions: Potential OPC and Partner Roles."[80] In it, the Council identifies the lead agency including the OPC itself and all partners including other agencies and non-governmental organizations. It also articulates the role of the OPC in implementing each objective including (1) coordination, collaboration, and integration; (2) policy guidance; and (3) funding. It states whether the OPC will serve a leading, direct, or supporting role in the implementation.

77 *Id.* at 116-117.
78 *Id.* at 164-165.
79 Gulf of Mexico Alliance, Implementation Activities Matrix, *available at* http://gulfofmexicoalliance.org/actionplan/welcome.html.
80 California Ocean Protection Council, A Vision for Our Ocean and Coast: Five-Year Strategic Plan (2006).

5.2. Identify the legal authority to act.

Rationale: To support the implementation plan and demonstrate how it can be achieved, some programs describe the legal authority under which action can be taken. In situations where the program is mandated by law, the statutory or regulatory text may delineate the legal authority for action and the agency responsible for implementation. For soft-law programs, the legal authority to act to implement the plan may not be clear. A memorandum of understanding may be used in some circumstances to provide the legal basis for an agency to participate in an EBM program. Otherwise, the plan itself may indicate the legal authority for specific actions. Clearly stated legal authority may be especially important for soft-law regional governance approaches that are not operating under specific legal mandates, as a way to demonstrate an institution's ability to achieve its commitments.

Example: Legal Mandate—California Ocean Protection Act and Massachusetts Oceans Act

The California Ocean Protection Act establishes the California Ocean Protection Council and designates the Secretary of the Resources Agency, Secretary for Environmental Protection, and Chair of the State Lands Commission as the council members.[81] It delineates the responsibilities of the Council including coordinating state agency activities, creating policies, and recommending changes to state and federal laws and policies.[82]

Under the Massachusetts Oceans Act, the Secretary of Energy and Environmental Affairs is granted "oversight, coordination and planning authority."[83] The law requires the Secretary, in consultation with an ocean advisory commission, to create an ocean plan; and once the plan is created "all certificates, licenses, permits and approvals for any proposed structures, uses or activities" in the planning area must be consistent with the plan.[84]

Example: Memorandum of Understanding—Chesapeake Bay

Memoranda of understanding or agreement (MOUs) help establish the role of different agencies in undertaking a regional governance program. While MOUs are soft-law agreements that do not create binding requirements or change other legal mandates, they do help delineate the actions of particular agencies or institutions. Also, some MOUs specifically indicate the legal authority that allows the agencies or institutions to participate or engage in specific activities.
Several MOUs pertain to the effective management of the Chesapeake Bay. For example, EPA and the U.S. Fish and Wildlife Service signed an MOU in 1988 to facilitate information

81 California Ocean Protection Act, Cal. Pub. Res. Code § 35600 (2004).
82 § 35615.
83 Mass. Gen Laws ch. 21A, § 4C(a) (2008).
84 § 4C(e).

exchange between agencies.[85] In the MOU, the agencies state the activities that will be undertaken to achieve their goals. It also lists existing responsibilities and activities including the laws under which the agencies act when engaging in information-gathering activities.

5.3. Estimate implementation cost, funding sources, and cost of inaction.

Rationale: To support the implementation plan and demonstrate how it can be achieved, some programs estimate the specific costs of implementation and sources of funding. The cost and funding sources will help the planning team to understand the potential for implementation success and to determine where fund-raising efforts may be needed. If an action is funded, the likelihood of successful implementation may be higher than for an unfunded action item. Also, determining the cost of implementation may help with priority-setting. However, a more nuanced cost-benefit analysis may be a better approach for setting priorities: in other words, it may be useful to balance the discussion of cost of action with the cost of inaction.

Example: Cost of Action—Chesapeake Bay Commission, Gulf of Maine Council on the Marine Environment, and Gulf of Mexico Alliance

In 2002, the Chesapeake Bay Commission began a study to determine the cost of implementing the Chesapeake 2000 plan.[86] The study found that the implementation cost was $18.7 billion, of which approximately $13 billion was still needed.[87] The Commission conducted this analysis as a first step in raising the necessary financial support[88] Its report breaks down available funding and funding needs by state (Maryland, Pennsylvania and Virginia), and for each state lists the funds available and needed for living resources, vital habitat, water quality, land use, and community engagement. Within each spending category, the funding and costs are further divided based on specific issues. For example, the vital habitat section includes funding and cost estimates for submerged aquatic vegetation, watersheds, wetlands, and forests. The Commission goes on to briefly consider the policy implications of the funding availability and shortfalls, and makes recommendations to prioritize action based on the cost and benefit of activities.

In addition to a specific five-year action plan, the Gulf of Maine Council created an 18-month work plan, which describes specific activities and provides information on activity financing. The financing section includes a list of tasks, the amount and type of cost (e.g. contractual, in-kind, printing, etc), and sources of funding. In some cases, the work plan demonstrates that

85 Memorandum of Understanding between the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency (1988), *available at* http://www.chesapeakebay.net/content/publications/cbp_12564.pdf.

86 Chesapeake Bay Commission, The Cost of a Clean Bay: Assessing Funding Needs Throughout the Watershed (2003), *available at* http://www.chesbay.state.va.us/Publications/C2Kfunding.pdf.

87 *Id.* at 2.

88 *Id.*

some activities are unfunded, which could limit the ability of the Council and its collaborators to implement portions of the plan.

While not describing the specific cost of different actions, the Alliance's Implementation Activities Matrix includes a list of contributors that have agreed to provide funding or in-kind support to achieve the activity.[89]

***Example: Cost of Inaction*—Stern Review on the Economics of Climate Change *and* The Sunken Billions**

The *Stern Review Report on the Economics of Climate Change* is a global assessment of the predicted impacts of climate change, the cost of climate change, and methods and costs of responding to such change.[90] It provides an example of how long-term economic analysis can help determine potential law and policy responses based on the cost of inaction versus the cost of action. By incorporating the revised risks of catastrophic climate change predicted by scientific uncertainty and newly discovered feedback loops, the report projects that past estimates of economic damage due to climate change have been too low, and that the actual damage would by equivalent to a permanent loss of 5 percent of global GDP if current trends continue. Factoring in non-market losses, as well as the disproportionate effect of climate change on developing countries due to their hotter climates, poorer water supplies, and higher dependence on agriculture, leads to an estimated 20 percent loss of global GDP. While this type of report likely would not be made part of an EBM final plan, analysis like this could contribute to the determination of the costs and benefits of different policy options. Evaluating the cost of inaction could also play an important role in making tradeoff decisions (discussed in Chapter VI).

The Sunken Billions is a report developed by the Sustainable Development Network to provide an economic justification for fisheries reform.[91] Similar to the *Stern Review*, this type of approach could be applied in the EBM context to develop plans and make tradeoffs. *The Sunken Billions* example highlights the use of economic costs and benefits to develop policy recommendations or solutions that maximize long-term economic well-being in addition to maintaining ecosystem function. The report finds that current operation of marine fisheries costs the global economy approximately $50 billion annually and $22 trillion over the last thirty years relative to optimal fishing practices, in addition to the economic losses from habitat destruction and the impact of illegal fishing. The report recommends a shift from the traditional maximum sustainable yield (MSY) approach to a broader approach of maximum economic yield (MEY),

89 Gulf of Mexico Alliance, Implementation Activities Matrix, *supra* note 79.

90 Nicholas Stern, Stern Review on the Economics of Climate Change (2006), *available at* http://www.hm-treasury.gov.uk/sternreview_index.htm.

91 Agriculture and Rural Development, Sustainable Development Network, The Sunken Billions: The Economic Justification for Fisheries Reform (2008), *available at* http://siteresources.worldbank.org/EXTARD/Resources/336681-1215724937571/SunkenBillionsAdvanceWebEd.pdf.

which is in most cases a smaller tonnage. The report recommends reducing the world's fishing capacity by approximately half.

III. ECOSYSTEM SCIENCE AND INFORMATION

A. Science and Information in Brief

Science-based natural resource management often considers species- or sector-specific information but falls far short of achieving a comprehensive understanding of the myriad components that interact to form a healthy ecosystem. Marine resource management is plagued by a more fundamental challenge—even the most basic information about physical structure, physical processes, and ecology is limited at best, let alone information to form a reasonable understanding of the complex interactions within functional marine ecosystems.
EBM programs can and do take a variety of approaches toward accessing or developing the data needed to make effective decisions. Potential approaches for addressing ecosystem science in decision-making include the following:

(1) Incorporate scientific decision-making throughout the EBM program.

- Require decision-making based on sound science.
- Use a science committee to serve as liaison to the scientific community and to advise the regional governance body.

(2) Use available data to inform management decisions.

- Use long-term monitoring data.
- Synthesize existing data to evaluate multiple parameters of the ecosystem.
- Map ecological and social data to inform decision-making.
- Synthesize existing data to evaluate cumulative human impacts.

(3) Collect new data to inform management decisions.

- Develop a research plan based on regional needs.
- Fund targeted research that informs management decisions.
- Be timely with data sharing.
- Use existing legal authority to consider multiple ecosystem parameters.
- Use permitting authority to ensure that permittees support ecosystem-based monitoring and research.

(4) Share information across sectors and jurisdictions.

- Establish linkages among institutions.
- Standardize information across jurisdictions and sectors.
- Develop regional information systems.

This Chapter briefly describes concrete U.S. examples of these four approaches, including describing the limitations of specific examples.

B. Science and Information in Practice

1. Incorporate Scientific Decision-Making throughout the EBM Program

1.1. Require decision-making based on sound science.

Rationale: Ecosystem-based management is a management approach that "explicitly accounts for the interconnectedness within systems."[92] This requires an understanding of ecosystem structure, function and processes in order to make the appropriate management decisions. Thus, science-based decision-making is an essential aspect of EBM. This includes using existing data and gathering new data in a way that informs ecosystem-based decisions. It may include, for example, the development and use of scientific advisory bodies to inform policy-makers, development of research plans to fill data gaps, and funding targeted science that supports management decisions.

Example: Ecosystem Decision-Making—California Ocean Protection Council

California takes a multi-faceted approach toward fully incorporating science into decision-making. In creating the California Ocean Protection Council, the California Ocean Protection Act stated that "[a] goal of all state actions shall be to improve monitoring and data gathering, and advance scientific understanding, to continually improve efforts to protect, conserve, restore, and manage coastal waters and ocean ecosystems."[93] It is also an explicit purpose of the Act to

92 McLeod et al., *supra* note 1.
93 Cal. Pub. Res. Code § 35510 (2004).

"[i]dentify scientific research and planning that is useful for the protection and conservation of coastal waters and ocean ecosystems, and coordinate and assist state agencies in addressing those needs."[94]

Several responsibilities of the Council relate to collecting important data and using it to inform management decisions. It is the role of the Council to "[e]stablish policies to coordinate the collection, evaluation, and sharing of scientific data related to coastal and ocean resources among agencies."[95] The Council is tasked with "[establishing] a science advisory team of distinguished scientists to assist the council in meeting the purpose of this division." [96] The Council is tasked with (1) contracting with the California Ocean Science Trust and other institutions to conduct needed research, and (2) transmitting research results to state agencies to inform policy decisions.[97]

Example: Sector-Based Decision-Making—Magnuson-Stevens Fishery Conservation and Management Act and the Marine Mammal Protection Act

Originally passed in 1976, then amended in 1996 and 2006, the Magnuson-Stevens Fishery Conservation and Management Act (MSA) has long been the dominant legislation governing fisheries management in the United States. Recognizing that "[t]he collection of reliable data is essential to the effective conservation, management, and scientific understanding of the fishery resources of the United States," one of the foundational policies of the MSA is "to assure that the national fishery conservation and management program utilizes, and is based upon, the best scientific information available."[98]

The MSA established eight regional fishery management councils (RFMCs). As of 2006, every new council member is expected to complete a training course developed by the Secretary of Commerce on a variety of relevant topics, such as "fishery science and basic stock assessment methods" and/or "fishery management techniques, data needs, and Council procedures."[99] The RFMCs are responsible for developing individual fishery management plans, which are statutorily required to be based upon the best scientific information available.[100] Each RFMC is also required to establish and maintain a scientific and statistical committee to "assist it in the development, collection, evaluation, and peer review of such statistical, biological, economic, social, and other scientific information as is relevant to such Council's development and amendment of any fishery management plan." The 2006 MSA amendments expanded the duties

94 § 35515.
95 § 35615(2).
96 § 35615(3).
97 §§ 35615(4)-(5).
98 Magnuson-Stevens Fishery Conservation and Management Act [hereinafter MSA], §§ 2(a)(8), (c)(3); 16 U.S.C. §§ 1802(a)(8), (c)(3) (2007).
99 MSA § 302(k); 16 U.S.C. § 1852(k). For more information on RFMC voting and non-voting member requirements and the nomination and appointment process, see §§ 302(a)-(d); §§ 1852(a)-(d) and 50 C.F.R. § 600.215 (2009).
100 MSA § 301(a)(2); 16 U.S.C. § 1851(a)(2).

of the scientific and statistical committee, requiring it to "provide its Council ongoing scientific advice for fishery management decisions."[101] Finally, each RFMC is required to work with its scientific and statistical committee to set five-year research priorities for fisheries, habitats, and other relevant fields.[102]

In addition to the research duties of the scientific and statistical committees, the Secretary of Commerce is required to maintain a comprehensive fishery research program that is "designed to acquire knowledge and information, including statistics, on fishery conservation and management and on the economics and social characteristics of the fisheries."[103] The 2006 MSA amendments additionally mandated that a regional ecosystem study be conducted. The study was to encompass "the state of the science for advancing the concepts and integration of ecosystem considerations in regional fishery management" and to include, among other things, "recommendations for scientific data, information and technology requirements for understanding ecosystem processes."[104]

Since 1972 the Marine Mammal Protection Act (MMPA) has prohibited the take of marine mammals in the U.S. The Secretary[105] has the authority to allow exceptions to the moratorium and to prescribe regulations for the taking and importing of marine mammals "on the basis of the best scientific evidence available and in consultation with the Marine Mammal Commission."[106] The requirement is more stringent when the Secretary is determining whether a species or stock is no longer depleted—in such cases the decision must be made "*solely*" based on the best scientific information available, and the determination must undergo notice-and-comment rulemaking.[107]

The MMPA also creates mechanisms for developing and analyzing the best scientific evidence available. The Marine Mammal Commission (Commission) consists of three presidential appointees knowledgeable in marine ecology and resource management, and among other things is required to study "the condition of the stocks of marine mammals, of methods for their protection and conservation, . . . [and] of research programs conducted or proposed to be conducted under the authority of this Act."[108] It must conduct or direct research it determines is necessary or desirable to achieve this objective, and make recommendations to federal entities

101 § 302(g)(1)(B); § 1852(g)(1)(B). Examples of the advice to be provided include recommendations for acceptable biological catch, preventing overfishing, and achieving rebuilding targets, and reports on stock status and health and the sustainability of fishing practices.
102 § 302(h)(7); § 1852(h)(7).
103 § 404(a); § 1881c(a).
104 § 406(f)(1); § 1882(f)(1).
105 The term "Secretary" refers to the Secretary of Commerce if the species under discussion is a member of the order Pinnipedia, other than walruses; or meaning the Secretary of the Interior for any other species. Marine Mammal Protection Act, § 3(12)(A); 16 U.S.C. § 1362(12)(A) (2006).
106 §§ 101(a)(3)(A), 103(a); §§ 1371(a)(3)(A), 1373(a).
107 § 115(a); § 1383b(a) (emphasis added).
108 § 202; § 1402.

regarding what must be done.[109] The Commission also is required to create a Committee of Scientific Advisors on Marine Mammals and to consult with the Committee "on all studies and recommendations which it may propose to make or has made, on research programs conducted or proposed to be conducted under the authority of this Act, and on all applications for permits for scientific research."[110]

In 1994 the MMPA was amended to include another important provision affecting the body of available scientific information. Section 117 implemented a stock assessment requirement for all marine mammals and established three regional scientific review groups. The Secretary must prepare stock assessments based on the best scientific information available, which address a variety of criteria ranging from geographic range to estimates of human-caused mortality and serious injury. These stock assessments undergo notice-and-comment rulemaking and are reviewed every 1-3 years. Further, three independent regional scientific review groups of experts in related fields were established to advise the Secretary on matters such as marine mammal population estimates, scientific uncertainties and research gaps, the impacts of habitat destruction, and other appropriate issues.[111]

1.2. Use a science committee to serve as liaison to the scientific community and advise the regional governance body.

Rationale: Existing scientific committees or structures may be in place and poised to serve as advisors to a regional ocean governance program. In the absence of existing bodies, a new science committee can serve as an important link to the scientific community and support science-based decision-making.

Example: State-Law Approach—California Ocean Sciences Trust and Ocean Protection Council, Puget Sound Partnership, Massachusetts Ocean Management Initiative

Established under the California Ocean Resources Stewardship Act of 2000, the California Ocean Sciences Trust has a mission to foster collaboration and make sure that the best science available is incorporated into ocean policy and management decisions.[112] Since the creation of the Ocean Protection Council (OPC), the Trust has taken on the responsibility of providing science advice to the OPC. The Executive Director of the Trust is formally named as the Science

109 § 202; § 1402.

110 §§ 203(a), (c); §§ 1403(a), (c). If the MMC does not adopt a recommendation made by the Committee, it must forward the recommendation to the appropriate Federal agency and explain its rationale.

111 § 117; § 1386.

112 California Ocean Sciences Trust, One-Page Summary (2008) (on file with authors).

Advisor to the OPC. In addition to providing advice, the Advisor serves as the OPC representative on relevant West Coast projects and activities.

The California Ocean Protection Act requires the establishment of a scientific advisory committee that is to include scientists from a range of disciplines and provide independent and timely analysis using best available science.[113] The science advisory committee has several responsibilities, including identifying and prioritizing research questions, and reviewing and evaluating research results to support OPC decisions.[114]

The Puget Sound Partnership is composed of three major bodies: the Leadership Council; the Ecosystem Coordination Board (which advises the Council and is made up of 27 members that represent different regional interests); and the Science Panel.[115] The nine-member Science Panel serves as an "independent, nonrepresentational" scientific body that identifies environmental indicators and benchmarks to incorporate into the Partnership's action plan.[116] The Science Panel also is tasked with identifying science gaps and making recommendations on research priorities, among other responsibilities.[117] Members of the Science Panel are appointed in a two-step process. The Washington Academy of Sciences nominates fifteen scientists that represent the full range of scientific disciplines and the Leadership Council appoints nine members from that list.[118]

In accordance with the Massachusetts Oceans Act of 2008, a science advisory council was established to assist the Secretary of Energy and Environmental Affairs in creating a baseline assessment and obtaining other necessary scientific information.[119] The science advisory council is made up of 9 members appointed by the Secretary. Three members must be from academic institutions, three from nonprofit organizations, and three from government agencies.[120] Since its inception, the science council has met three times and is working toward a baseline assessment. In addition to the science advisory input, ocean management planning includes the creation of six agency working groups.[121] The working groups prepare reports synthesizing available data on the following topics: (1) habitat, (2) fisheries, (3) transportation, navigation, and infrastructure, (4) sediment, (5) recreation and cultural services, and (6) renewable energy.[122]

113 Cal. Pub. Res. Code § 35615(3) (2004).
114 § 35615(3).
115 Puget Sound Partnership, *at* http://www.psp.wa.gov/.
116 ESSB 5372 § 9 (2007).
117 § 10.
118 § 9.
119 Mass. Gen. Law ch. 21A § 4C(d) (2007).
120 § 4C(d).
121 Massachusetts Executive Office of Energy and Environmental Affairs, *Ocean Planning Technical Materials*, *at* http://www.mass.gov/?pageID=eoeeaterminal&L=3&L0=Home&L1=Ocean+%26+Coastal+Management&L2=Massachusetts+Ocean+Plan&sid=Eoeea&b=terminalcontent&f=eea_oceans_tech_materials&csid=Eoeea.
122 *Id.*

Example: Soft-Law and Federal Approach—Chesapeake Bay Program

The Chesapeake Bay Program has a Scientific and Technical Advisory Committee that provides guidance to the Program on measures to restore and protect the Bay. Its actions include developing technical reports and papers, leading discussion groups, assisting in project reviews, developing technical conferences and workshops, and working with the Chesapeake Bay Program subcommittees and workgroups.[123] For example, in response to the *Chesapeake 2000* agreement, the Committee developed a scientific and technical needs report that identifies scientific and technical priorities to satisfy the goals related to living resources, habitat, water quality, sustainable development, and stewardship.[124]

The federal Chesapeake Bay Restoration Act of 2000 requires the U.S. EPA to continue its Chesapeake Bay Program Office, which is tasked with "implementing and coordinating science, research, modeling, support services, monitoring, data collection, and other activities that support the Chesapeake Bay Program."[125] The Act also requires the Chesapeake Bay Program Office to provide information through publications and technical assistance; cooperate with other local, state, and federal bodies to implement the Chesapeake Bay Agreement; coordinate EPA's actions with other agencies to improve water quality and living resources; and implement outreach programs.[126]

2. Use Available Data to Inform Management Decisions

Several ELI interviews and meetings revealed that there is a lack of support for long-term monitoring of ecosystem function and health. In part this is due to government and foundation funding priorities. For example, Governor Schwarzenegger used his line-item veto power in 2008 to cut funding for coastal water quality monitoring by $984,000 in response to the financial crisis facing California.[127] Lack of long-term monitoring support also is due to funding cycles: granting agencies often fund for a few years at a time at most.[128] While long-term data sets can provide substantial information about ecosystem change over time—for example, the famous

123 Chesapeake Bay Program's Scientific and Technical Advisory Committee, *About STAC*, *at* http://www.chesapeake.org/stac/stacinfo.

124 Chesapeake Bay Program's Scientific and Technical Advisory Committee, *Scientific and Technical Needs Assessment*, *at* http://www.chesapeake.org/stac/STNeeds.html#STN.

125 Chesapeake Bay Restoration Act of 2000, § 117(b).

126 § 117(b).

127 *See, e.g.,* Terry Rodgers, *Program to Check Beaches Curtailed*, Union Tribune (Sept 25, 2008), *at* http://www.signonsandiego.com/news/metro/20080925-9999-1m25beach.html.

128 *See, e.g.,* Todd Reeve et al., *Building Science and Accountability into Community-Based Restoration: Can a New Funding Approach Facilitate Effective and Accountable Restoration?*, 31 Fisheries 17 (2006) (describing the challenges that Bonneville Environmental Foundation and its grantees face in conducting restoration projects that include adequate monitoring and evaluation including short term funding cycles).

Keeling Curve demonstrating CO_2 rise in the atmosphere—monitoring often is an activity that does not top the list of priorities for governments, funding agencies, and researchers, making it difficult for these projects to compete in a grant-driven research world.[129] Yet increased generation and use of such data is precisely what is required for ecosystem-based decision-making and governance.

2.1. Use long-term monitoring data.

Rationale: Monitoring provides important baseline data about the health of the ecosystem. It is useful both for early detection of sudden changes, such as the introduction of an invasive species; and to demonstrate subtle changes over time, such as the long-term monitoring data of CO2 emissions. Monitoring is seen as an essential way to determine whether investments and activities are having a positive impact on the health of the ecosystem, and is therefore critical for adaptive management strategies.[130]

Example: Data Sources—Integrated Ocean Observing System Regional Associations

Resource managers and others could use the data sets generated through Regional Associations (RAs) to inform EBM decisions.[131] RAs often use remote sensing equipment that can produce long-term data-sets. Some of the data are available on a real-time basis, which could be an effective way to detect rapid changes. For example, at the Scripps Pier in Southern California, one of the data collection sites for the Southern California Coastal Ocean Observing System (SCOOS), data are collected on chlorophyll, pressure, salinity, and temperature. Moorings in Southern California provide additional information on currents and winds, and dissolved oxygen. Also, SCOOS provides total coliform, fecal coliform, and enterococci data at many sites along the Southern California coasts. Stormwater plumes also are tracked at several locations in that region. Such data could help inform EBM decisions, planning, and evaluation of program success.

Example: Data Sets—National Assessments Database and National Land Cover Dataset

The U.S. EPA hosts the National Assessments Database, which includes water quality information submitted by the states as required under the Clean Water Act.[132] It included

129 *See, e.g.,* Jeffrey Mervis, *NOAA Loses Funding to Gather Long-Term Climate Data*, 307 Science 188 (2005) (describing the congressional spending cuts that eliminated funding for 110 climate observing stations and decreased funding to the famous Keeling Curve Mauna Loa site).

130 *See, e.g.,* Ricardo Bayon, et al., Environmental Funds: Lessons Learned and Future Prospects (1999), *available at* http://economics.iucn.org.

131 *See Appendix A: Useful Organizations* for more information about the Integrated Ocean Observing System and Regional Associations.

132 EPA, National Assessments Database, *at* http://www.epa.gov/waters/305b/.

water quality information for bays, estuaries, and coastal shorelines, as well as freshwater sources. Water bodies are listed by 8-digit US Geological Survey cataloging units and are listed as "good," "threatened," or "impaired." For impaired water bodies the database includes information on the cause and source of impairments. The information collected by the states and made available through this database is used to inform regulation of discharges from point sources and management of nonpoint sources of pollution. The Database website includes an "Enviromapper for Water" that provides spatial data about water quality and analysis including, for example, impaired waters, combined sewer overflow points, jurisdictional boundaries, and EPA water monitoring stations. One limitation of the National Assessments Database is that states use different methods to assess water quality, meaning that water quality conditions cannot be compared across states or used to analyze national or regional trends.

The Multi-Resolution Land Characteristics Consortium is a federal multi-agency partnership that has used satellite imagery to develop its database.[133] Lands are classified in one of 21 different classes of land cover including, for example, open water, low-intensity developed land, high-intensity developed land, cultivated crops, and emergent herbaceous wetlands. Data is available for use by federal and state agencies and groups or individuals for non-commercial ventures.

2.2. Synthesize existing data to evaluate multiple parameters of the ecosystem.

Rationale: Targeted data often informs managers about specific aspects of ecosystem function. However, there are relatively few examples of data sets that have been combined to indicate the overall health and sustainability of an entire ecosystem. In order to manage an ecosystem effectively, regions could support baseline ecosystem assessments using existing data. The following examples include sector-specific ecosystem assessments as well as national assessments that could inform regional programs.

Example: Synthesizing Regional Data—Aleutian Islands Fishery Ecosystem Plan and Southern California Coastal Water Research Project

The North Pacific Fishery Management Council (NPFMC) appointed the Aleutian Islands Ecosystem Team to draft the Aleutian Islands Fishery Ecosystem Plan (AIFEP). The goals of the AIFEP are to integrate information from across fishery management plans and NEPA documents, identify indicators to evaluate ecosystem health, focus on tool development and refinement, identify research needs, and help the NPFMC set management goals and objectives and understand the cumulative effects of management actions.[134]

133 Multi-Resolution Land Characteristics Consortium (MRLC), National Land Cover Database, *at* http://www.mrlc.gov/index.php.

134 Aleutian Islands Ecosystem Team, *supra* note 50 at 2.

The ecosystem plan has some limitations. Unlike fishery management plans that serve as the foundation for the regulatory program, the AIFEP is purely a planning and policy document with no legal authority. However, the North Pacific Fishery Management Council has expressed its intent to "[work] through the various considerations and recommendations identified in the plan, and [refine] them for Council action."[135] The Council also intends to update the plan annually and re-evaluate it every 3-5 years.

Created in 1969, the Southern California Coastal Water Research Project (SCCWRP) brings together multiple state and federal agencies to conduct coastal environmental research.[136] To evaluate the status of the coastal ecosystem, SCCWRP takes an interdisciplinary approach to examine marine ecology, oceanography, chemistry of contaminants, and contaminant inputs.[137] Research includes region-wide surveys and monitoring.[138]

Example: Synthesizing National Data—National Coastal Condition Report and National Estuarine Eutrophication Assessment

The National Estuarine Eutrophication Assessment (NEEA) evaluates both the current conditions of estuaries and, in the 2008 update of the original 1999 document, changes in eutrophication status since the late nineties.[139] It evaluates the effectiveness of ongoing management efforts, outlines potential solutions for eutrophication problems, and indicates research needs. The primary tool used to gather data in the most recent update was an online survey of experts employing the ASSETS (ASSessment of Estuarine Trophic Status) method, while the original survey was conducted through site visits and regional workshops. The most recent NEEA includes national and international case studies illustrating the impacts of eutrophication as well as of particular management techniques.[140]

Data gaps and management connections are limitations of this assessment. To conduct the update, the authors used self-reporting methods, which resulted in gathering information on 70 percent of systems, as opposed to 88 percent of systems in the original document. The report suggests that such data gaps could be filled by integrating existing monitoring programs such as the Integrated Ocean Observation System (IOOS) and the National Water Quality Monitoring Network (NWQMN) into the self-reporting mechanism. The report only provides ground-level

135 North Pacific Fishery Management Council, Current Issues 16 (2008).

136 Southern California Coastal Water Research Project, *About SCCWRP, at* http://www.sccwrp.org/view.php?id=34.

137 Alan J. Mearns, M. James Allen & Michael D. Moore, *The Southern California Coastal Water Research Project—30 Years of Environmental Research in the Southern California Bight, in* SCCWRP 1999 Annual Report, *available at* ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/1999AnnualReport/01_ar01.pdf.

138 *Id.* at 19-20.

139 S. Bricker et al., *Effects of Nutrient Enrichment In the Nation's Estuaries: A Decade of Change*, NOAA Coastal Ocean Program Decision Analysis Series No. 26 (2007); National Ocean Service, *National Estuarine Eutrophication Assessment: Effects of Nutrient Enrichment in the Nation's Estuaries* (1999).

140 *Id.*

management strategies for individual case studies, and its final recommendations are limited to improved communication with the public and with regulatory agencies.

The Clean Water Act mandates that the EPA report periodically on the condition of the country's coastal waters, which EPA does systematically through the National Coastal Condition Report. The third report released in 2008 tracks trends in coastal condition between 1990 and 2002.[141] The report compiles standardized data from a wide range of governmental sources, including the EPA's Environmental Monitoring and Assessment Program (EMAP), NOAA's National Status and Trends (NST) and Marine Monitoring and Assessment Programs, the FWS's National Wetlands Inventory (NWI), and the State of the Lakes Conference (SOLEC). The report also uses data from states and other regulatory agencies concerning public use of coastal areas, although such data is gathered using various methodologies and thus cannot be used for broad comparisons.

It should be noted that the National Coastal Condition Report is purely an assessment, and while it does identify changes in coastal condition and identify potential sources of such change, it does not make specific recommendations linking the data to management action. Additionally, the existing report does not include most of Alaska, although future reports will correct this deficiency.

2.3. Map ecological and social data to inform decision-making.

Rationale: Mapping data is an increasingly popular way to synthesize ecosystem information and communicate that information to decision-makers and the public. It is an essential element of marine spatial planning and management—an approach that is increasingly seen as the best way to achieve EBM.

Example: State-Based Approach—New York Ocean and Great Lakes Ecosystem Conservation Council

The New York Council has developed an online mapping program, the Atlas, which includes more than 300 datasets. The Atlas is meant to provide citizens and decision-makers with spatial information about New York's ecosystems, including both administrative and ecological information.[142] Administrative information includes county jurisdictional boundaries, major cities, and area designations such as fishery closures and marine protected areas. Biological and physical information includes, for example, invasive species locations, sea grass habitat, and watershed boundaries.

141 EPA, National Coastal Condition Report III (2008).

142 New York Ocean and Great Lakes Ecosystem Conservation Council Announcement, on file with authors.

Example: National Approach—NOAA Coastal Services Center

Tools under development by NOAA's Coastal Services Center (CSC) include the "Digital Coast Legislative Atlas," which includes topographical and habitat data as well as regulatory boundaries, and "georegulations"—spatial representation of coastal and ocean laws. For example, those considering developing a regional ocean governance program could review the Legislative Atlas to determine the appropriate federal agencies and regional offices to include in such a program. CSC is also working to support development of the marine cadastre, called for in the Energy Policy Act of 2005, to help in siting decisions for alternative energy production on the Outer Continental Shelf.[143]

The Legislative Atlas is still under development. Most of the mapped data relates to federal laws and institutions. Some region-specific state laws and institutions have been added or are in the process of being added. Also, while the Atlas provides basic information about jurisdictional boundaries and applicable laws, it does not provide the nuanced details that would be needed for an in-depth law and policy analysis.

2.4. Synthesize existing data to evaluate cumulative human impact.

Rationale: One of the challenges with ecosystem management is understanding the multiple human-caused impacts on the ecosystem. New efforts are underway to develop computer-based methods to quantitatively evaluate multiple human impacts on different marine habitats.

Example: National Center for Ecological Analysis and Synthesis Human Impacts Study

In early 2008, a study o mapping of human impact on marine ecosystems led by Benjamin S. Halpern and funded by the National Center for Ecological Analysis and Synthesis (NCEAS) was published in *Science*. The research team compiled data on 17 anthropogenic drivers, which encompassed the effects of climate change, fishing, and pollution, although data was not available for recreational fishing, aquaculture, disease, coastal engineering (habitat alteration), point-source pollution, IUU fishing, and atmospheric pollution.[144] The drivers were then impact-weighted according to standardized, quantitative estimates of the varying effects each of the activities would have in 20 different ecosystems.[145] The project goal was to create a mapping

143 Nat'l Oceanic & Atmospheric Admin. [hereinafter NOAA], Coastal Services Center, Digital Coast: Legislative Atlas, *at* http://www.csc.noaa.gov/legislativeatlas/.

144 Halpern et al., *Global Map*, *supra* note 4 at 950–951. The seventeen drivers were: benthic structures, commercial shipping, ocean-based pollution, species invasion, ocean acidification, UV, sea temperature, artisanal, low-bycatch, high-bycatch, non-habitat-modifying low-bycatch, non-habitat-modifying hi-bycatch, habitat-modifying, direct human, nonpoint inorganic, nonpoint organic, nutrient input.

145 *Id.* at 948–49.

model that would account not only for the extent of human activities, but for the relative effects of those activities. The result was a 1 km^2 resolution map of *human impact* on global marine ecosystems, not just the *human footprint* (see Figure 1, *supra* p.2).[146]

Mapping the spatial variation in estimated human impact enables interested parties to both spatially manage drivers (e.g., rerouting shipping lanes to protect highly impacted or sensitive areas) and to prioritize regional planning efforts (e.g., addressing drivers with the highest impact scores first). In short, knowing the relative impact of different anthropogenic activities makes it possible for parties to maximize the tradeoff between desired activities and ecological effects.[147]

The model created by Halpern *et al.* demonstrates the feasibility of such large-scale maps and offers a starting point for similar but local-scale efforts.

Example: Use Marine Geospatial Ecology Tools to Make Management Decisions

Dr. Patrick N. Halpin specializes in using geographic information systems (GIS) to link marine management and conservation to ecological processes. At the Marine Geospatial Ecology Lab at Duke University, Dr. Halpin's team of researchers has developed a library of open-source programming tools for marine researchers and GIS analysts. Accessible through ArcGIS or as a set of Python modules and COM components, Marine Geospatial Ecology Tools (MGET) is a collection of modeling tools designed for spatially-explicit ecological and oceanographic data.[148] The potential uses of MGET are numerous, ranging from habitat modeling to processing remotely-sensed data. For example, from spatially-explicit species observation data and oceanographic images, MGET can fit and evaluate a multivariate statistical model that predicts the probability of species occurrence; or MGET can simply automate the laborious process of sampling dynamic variables or converting HDF oceanography products to ArcGIS rasters.[149]

The continually growing suite of tools is designed to enable marine and coastal researchers to link spatial and temporal data with ecological processes to inform conservation and management. If spatially-explicit data on human activities were available and inputted, marine management could be informed by information on correlations between specific activities and ecological impacts. MGET allows detailed, small-scale modeling of the individual impacts that Halpern *et al.* analyzed cumulatively for the global ocean.

146 *Id.* at 948–49.

147 *Id.* at 950–51.

148 For more information on the technical specifics and potential uses of MGET, *see* http://code.env.duke.edu/projects/mget.

149 For detailed explanations of these and other examples, *see* http://code.env.duke.edu/projects/mget/wiki/MGET%20examples.

3. Collect New Data to Inform Management Decisions

3.1. Develop a research plan based on regional needs.

Rationale: To ensure that research supports regional needs based on the vision and goals of the program, EBM programs should make use of existing research plans or establish mechanisms to develop research plans as part of the EBM program.

Example: Multi-State Approach—Sea Grant Regional Research Support

Several aspects of Sea Grant make it an ideal information source when developing and implementing an EBM program. First, Sea Grant supports regional coastal research that informs management decisions. Second, regional Sea Grant programs are working together to develop regional research agendas based on a needs assessment. Third, each Sea Grant program has several field agents who work directly with the ocean community to answer important research questions.

Example: Single-State Approach—Puget Sound Partnership

According to state law, the Puget Sound Partnership Science Panel, after an initial assessment, is to submit updates to the Executive Director to reflect new scientific understanding. The updates are to:

> (b) Describe the current scientific understanding of various physical attributes of Puget Sound;
> (c) Serve as the scientific basis for the selection of environmental indicators measuring the health of Puget Sound; and
> (d) Serve as the scientific basis for the status and trends of those environmental indicators.[150]

The Science Panel also is tasked with developing a biennial science work plan that includes an identification of scientific and technical recommendations; a description of science-based activities in the Sound; scientific gap analysis; specific biennial science actions to address needs; and recommendations for improvements to ongoing scientific endeavors.[151]

150 ESSB 5372 § 11(3) (2007).
151 § 11(5).

Example: Federal Approach—Joint Subcommittee on Ocean Science and Technology Ocean Research Priorities Plan and Implementation Strategy

Established in response to the U.S. Commission on Ocean Policy recommendations, the Joint Subcommittee on Ocean Science and Technology (JSOST) developed a national Ocean Research Priorities Plan and Implementation Strategy that identifies research priorities for "the most compelling issues in key areas of interaction between society and the ocean."[152] JSOST developed the plan through a participatory process that included consultation and contributions from scientists and technical experts, resource managers, and others participating in workshops and conferences and responding to draft documents.[153]

The Research Plan includes an articulated vision of future knowledge to help guide the research plan development.[154] It identifies critical elements of science and technology, including: "developing the understanding and capability to forecast ocean processes; providing the scientific information needed to support ecosystem-based management, particularly in coastal and nearshore environments; and accelerating deployment of an ocean-observing system that will, in turn, advance both forecasting and adaptive ecosystem-based management capabilities."[155] The Plan includes six themes related to stewardship, natural hazards and resilience, marine operations, climate and ocean, ecosystem health, and human health.[156] The Plan identifies twenty ocean research priorities and four near-term priorities.[157]

3.2. Fund targeted research that informs management decisions.

Rationale: Not only is it necessary to fund research that supports management objectives, but the funds should include reporting requirements that ensure that data is translated to managers in a timely fashion.

Example: Creating a Trust—California Ocean Science Trust

The California Ocean Science Trust works with Sea Grant to manage the California Ocean Protection Council's funds for research. Research funds are being used to support ecosystem-based research that has direct applicability to regional ecosystem planning and management.

152 Committee on Ocean Policy, NSTC Joint Subcommittee on Ocean Science and Technology [hereinafter JSOST], *Ocean Research Priorities Plan and Implementation Strategy*, *at* http://ocean.ceq.gov/about/sup_jsost_prioritiesplan.html.
153 JSOST, Charting the Course for Ocean Science for the United States for the Next Decade: An Ocean Research Priorities Plan and Implementation Strategy (2007), *available at* http://ocean.ceq.gov/about/docs/orppfinal.pdf.
154 *Id.* at 1.
155 *Id.* at 4.
156 *Id.* at 9.
157 *Id.* at 10.

The Trust helps to ensure that OPC-funded research targets the objectives of the OPC Five-year Strategic Plan.[158]

Example: Regional Opportunities—IOOS Regional Associations

Regional organizations, federal and state agencies, academics, NGOs, and businesses may participate in the development and work of the Integrated Ocean Observing System (IOOS) Regional Associations (RAs). Members have the opportunity to help shape the direction of the RA. EBM programs or representatives could join RAs or otherwise work with them to develop needed scientific data.[159] Membership varies according to the MOUs and bylaws under which the RAs operate. Some membership requires dues that are paid as flat fees or on a sliding scale. To date, the IOOS RAs provide physical and chemical data and have minimal biological information. Data collection and availability varies according to region.

3.3. Be timely with data sharing.

Rationale: There is often a temporal disconnect between management action and scientific research and monitoring. Managers may need to make decisions on a relatively quick schedule, whereas conducting accurate scientific assessment to inform a management decision may take much longer. There is a need to have a system of information sharing that allows managers to understand research progress and interim results, while waiting for a report or publication that fully analyzes a research question.

Example: Interim Reports—Chesapeake Bay Program

One of the challenges with science-based management is obtaining the information necessary to make management decisions in a timely fashion. Institutional disconnects exist between those in need of scientific information for decision-making and those conducting research. For example, government institutions and actors may need information as it is collected, whereas scientific institutions and actors may prefer to collect robust publishable data before sharing the information. The Chesapeake Bay Program has tried to address this information-sharing gap by requiring quarterly reports from grantees that indicate research progress.[160] Not only does this create accountability mechanisms, but it may help managers make better decisions in the face of scientific uncertainty.

158 California Ocean Science Trust, *Science Services to the Ocean Protection Council*, *at* http://www.calost.org/science_services_OPC.html.

159 *See,e.g.,* GoMOOS, *Membership in GoMOOS*, at http://www.gomoos.org/membership/.

160 Personal communication, on file with authors (Nov 17, 2008).

3.4. Use existing legal authority to consider multiple ecosystem parameters.

Rationale: Many environmental laws provide the legal authority for government institutions to conduct research on multiple ecosystem parameters that affect the particular sector-based resource.

Example: Sector-Based Approach to Considering Ecosystem—Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) authorizes the consideration of broad ecosystem parameters in conducting research to support fisheries conservation and management. Even prior to the 2006 reauthorization, the language of the MSA allowed for fisheries research that considers multiple ecosystem parameters. Section 404(c) of the Act lays out the areas of research and includes "[r]esearch to support fishery conservation and management, including but not limited to, biological research concerning the abundance and life history parameters of stocks of fish, the interdependence of fisheries or stocks of fish, the identification of essential fish habitat, the impact of pollution on fish populations, the impact of wetland and estuarine degradation, and other factors affecting the abundance and availability of fish."[161]

This provision would presumably allow a fisheries research program to meet EBM objectives—an approach bolstered by the 1996 and 2007 amendments. Under the Sustainable Fisheries Act (the 1996 amendments reauthorizing the MSA), an advisory panel was established to make recommendations about "the extent to which ecosystem principles are being applied in fishery conservation and management activities, including research activities" (§406(a)-(e)). The resulting Ecosystem Principles Advisory Panel published its report to Congress in 1998, which includes recommendations for implementing ecosystem principles, goals and policies.[162] Its primary recommendation was for each regional council to develop a fishery ecosystem plan.[163] These recommendations directly informed the development of the Aleutian Islands Fishery Ecosystem Plan and the Chesapeake Bay Fishery Ecosystem Plan, described in greater detail in the planning chapter. Section 406 was further amended in 2006 to include part (f) "Regional Ecosystem Research." This provision calls upon the Secretary of Commerce, in consultation with the Marine Fisheries Councils, to "undertake and complete a study on the state of the science for advancing the concepts and integration of ecosystem considerations in regional fishery management."[164]

161 MSA § 404(c); 16 U.S.C. § 1881c(c) (2007).

162 Ecosystem Principles Advisory Panel, Ecosystem-Based Fisheries Management: A Report to Congress, *available at* http://www.nmfs.noaa.gov/sfa/EPAPrpt.pdf.

163 *Id.* at 27.

164 MSA § 406(f); 16 U.S.C. § 1882(f) (2007).

Example: Ecosystem Approach to Water Quality Management—Maine's Tiered Aquatic Life Uses

Under the Clean Water Act, states establish water quality standards by designating uses and creating criteria to support those uses.[165] Designated uses can relate to the health of species as well as how humans use the water body—e.g., recreation, fishing, and drinking water.[166] States create criteria for different designated uses. Criteria can be based on human health, nutrients, and/or biological parameters, among others.[167] Maine has developed "tiered aquatic life uses," making water quality management decisions based on quantitative ecosystem data that indicates the health of the aquatic life in the water body.[168] It classifies water habitat as natural, very good (unimpaired), sustainable (maintaining structure and function), and degraded (non-attainment of minimum standard). To determine health of the ecosystem, the state measures a variety of ecological parameters including species richness and abundance, diversity, indicator taxa, and trophic groups.[169]

3.4. Use permitting authority to ensure that permittees support ecosystem-based monitoring and research.

Rationale: Data collection is costly and time consuming. In certain instances it may be more appropriate for permit-holders to be tasked with data collection as a condition of receiving their permit. This can allow for expanded data collection programs that minimize the costs to government. However, in some instances, communities may be suspicious of data collected by those developing, extracting, or polluting the resource.[170]

Example: Magnuson-Stevens Fishery Conservation and Management Act

Under MSA Section 401, the Secretary of Commerce is required to develop recommendations for a standardized vessel registration and information management system. Under this provision, the Secretary is called upon to make recommendations on requiring fish processors, fish dealers and other ex-vessel purchasers to submit information (§ 401(9)). Fishing permits are tied to

165 EPA, *Water Quality Standards*, *at* http://www.epa.gov/waterscience/standards/.

166 EPA, *Designated Uses*, *at* http://www.epa.gov/waterscience/standards/uses/index.html.

167 EPA, *Water Quality Criteria*, *at* http://www.epa.gov/waterscience/criteria/.

168 Susan P. Davies, *Maine's Tiered Aquatic Life Standards and Biological Criteria* (2003) (presentation), *available at* http://epa.gov/waterscience/biocriteria/modules/wqs101-04-maine-tiered-standards-biocriteria.pdf.

169 *Id.* For more information, see Maine Bureau of Land & Water Quality, *Monitoring and Assessment*, *at* http://www.maine.gov/dep/blwq/monitoring.htm.

170 For example, some local resource users in the Arctic are concerned that the main source of marine science is funded or research conducted by the oil and gas industry, and there is concern that the data may be biased in favor of that industry. Personal communication with community organization (Oct 2008).

specific regulatory requirements, including reporting requirements, which typically relate directly to the fishing activity rather than broader ecosystem information. For example, in the Northeast Region, fishers are required to submit weekly trip reports when fish are received or purchased that include dealer information, vessel information, dates of purchase, price per unit, and landing port.[171] Also, in some fisheries, permit holders must carry observers onboard. Observers often collect scientific data in addition to reporting violations. Permits could be granted conditionally, and require additional data collection that would target broader ecosystem information.

Example: North Carolina In-Stream Water Quality Monitoring Requirements

In North Carolina, the Division of Water Quality collects instream monitoring data on a watershed basis in order to better assess the water quality of the ecosystem through the monitoring efforts of dischargers.[172] Today, six coalitions in four river basins work together to monitor 269 stations. The coalitions are created through memoranda of agreement (MOAs) between the dischargers and the Division. For example, the Lower Neuse Basin MOA creates upstream and downstream water quality monitoring requirements for permit-holders,[173] who collect data on temperature, dissolved oxygen, pH, nutrients, metals, turbidity, fecal coliform, and chlorophyll a.[174] A single state certified laboratory analyzes data for the coalition region, allowing for more consistent and comparable data. The Division collects this data and currently has more than 50,000 records in its database.

Example: Wave Energy Development

The Federal Energy Regulatory Commission (FERC) claims authority to regulate "hydrokinetic energy"—energy from waves, tides, and currents—in navigable waters of the U.S., including ocean and coastal waters. The authorizing law, the Federal Power Act, requires that licenses issued must include conditions for protection, mitigation, and enhancement "in order to adequately and equitably protect, mitigate damages to, and enhance, fish and wildlife,"[175] as well as other conditions that the Commission may require.[176] In issuing an order to the Makah Tribe for the licensing of a wave energy project in the Olympic National Marine Sanctuary, the Commission required the development of several fish and wildlife plans in consultation with NOAA's National Marine Sanctuary Program, the Makah Tribe, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Washington Department of Fish and Wildlife, and

171 NOAA, National Marine Fisheries Service [hereinafter NOAA Fisheries], Northeast Region, Reporting Guidelines for Federally Permitted Seafood Dealers in the Northeast Region, *available at* http://www.nero.noaa.gov/dealer_er/highlights/DER_guidelines.pdf.

172 North Carolina Division of Water Quality, *NPDES Discharge Monitoring Coalitions*, *at* http://h2o.ehnr.state.nc.us/esb/coalitions.html.

173 Memorandum of Agreement between the State of North Carolina's Division of Water Quality and the Lower River Basin Association Permittees (Effective Feb. 1, 2004 – Jul. 30, 2009), *available at* http://h2o.ehnr.state.nc.us/esb/coalitions.html.

174 *Id.* at Appendix A.

175 16 U.S.C. § 803(j) (2000).

176 § 803(g).

the Washington State Department of Ecology.[177] These include plans for epibenthic studies before and after installation, macroalgae and eelgrass surveys, water quality monitoring, noise assessment, and marine mammal mitigation and monitoring.[178]

4. Share Information across Jurisdictions and Sectors

4.1. Establish linkages among institutions.

Rationale: Often information that can support EBM planning and decision-making already exists. However, the information may not be easily accessible or even in a form that is useful for management. Without proper communication and collaboration, agencies may not fully incorporate available information from other agencies or may conduct redundant research.

Example: Regional Science Collaboration—North Slope Science Initiative

The North Slope Science Initiative (NSSI) in Alaska provides an example of regional science collaboration. The goal of NSSI is to increase inter-agency collaboration to address research, inventory, and monitoring needs.[179] A collaborative approach such as this could be linked to a regional governance program or form a part of a regional governance program that facilitates information transfer among scientists and to the management and policy community. Specifically, any regional EBM program that focuses on the Chukchi and Beaufort Seas should consider working with NSSI to accomplish EBM science objectives. One challenge with NSSI is that it was not created with additional funds to ensure implementation. According to the Charter, member agencies are responsible for their own expenses. In interviews with people working in the North Slope region, ELI learned that several people consider NSSI to be ineffective thus far at creating the needed collaborative management.

Example: Online Networking—EBM Tools Network

The Ecosystem Based Management Tools Network supports the creation and use of EBM tools in marine, coastal, and watershed contexts. Membership includes groups that create EBM tools and those that use such tools in academic, governmental, and non-governmental settings. The network itself is coordinated by NatureServe. The group's primary creation is a public

177 Federal Energy Regulatory Commission 122 FERC ¶ 61,248, Order on Rehearing and Clarification and Amending License 14 (Mar 20, 2008).
178 *Id. at* 13-14.
179 North Slop Science Initiative, Introduction, *at* http://mtri.org/QuickPlace/northslope/Main.nsf/h_Toc/c5babd578ff33f68852572ac005004f4/?OpenDocument.

database of existing EBM tools, allowing those developing EBM programs to find and utilize the most appropriate tools. The EBM Tools network particularly encourages development in areas considered underserved, such as integrated land-sea planning and social science modeling. The Network generally promotes best practices for the use and creation of EBM tools with a particular focus on their interactivity, and has recently begun a tools training program educating EBM practitioners on currently available tools and associated resources. The Network also serves as a resource for funding, technical assistance and data, streamlining EBM tool development and application through a full range of informational services.[180]

4.2. Standardize information across jurisdictions and sectors.

Rationale: Scientists may run into challenges synthesizing ecosystem information because of the various data collection methods and reporting approaches. Without standardized protocols for data collection and storage, researchers may have difficulty accurately synthesizing existing information.

Example: Federal Fisheries Management

As part of the 1996 Sustainable Fisheries Act amendments, the Magnuson Stevens Fishery Management and Conservation Act calls upon the Secretary of Commerce, in cooperation with the Coast Guard, states, fishery councils, and fishery commissions, to develop recommendations for implementing a standardized fishing vessel registration and information management system on a regional basis.[181] This provision requires recommendations that relate to vessel registration, information collection requirements under the MSA as well as other marine resource laws including the Marine Mammal Protection Act, and implementation through cooperative agreements, among others.[182] It also requires recommendations related to the establishment of standardized units of measurement, nomenclature, and formats for the collection and dissemination of information.[183]

The result of the registration and information system requirements was a 1998 report to Congress that described a model National Fisheries Information System, and, in 2003, NOAA Fisheries took the first steps toward developing the system.[184] The Fishery Information System projects include a National Permit System Project to harmonize fishing permits systems across NOAA;

180 Ecosystem Based Management Tools Network Website, http://www.ebmtools.org/.
181 MSA § 401(a); 16 U.S.C. § 1881(a) (2007).
182 §§ 401(a)(1)-(4); §§ 1881(a)(1)-(4).
183 § 401(a)(6); § 1881(a)(6).
184 NOAA Fisheries Information System, *About FIS*, *at* http://www.st.nmfs.noaa.gov/fis/about/what.html; NOAA Fisheries, Proposed Implementation of a Fishing Vessel Registration and Fisheries Information System: Report to Congress (1998).

the Commercial Landings Integration Project to integrate regional commercial landing data at the national level; the Pacific electronic fish ticket to capture and track fish ticket data; the Trip Data Reconciliation Project to reconcile disparate data sets; the Electronic Reporting Roadmap related to the use of vessel monitoring system data;[185] and the FIS InPort Metadata Catalog allowing NOAA and state and regional partners to share fisheries-dependent data and understand the "what, where, when, how, and who" about the data holdings; among other projects.[186]

Example: Southern California Coastal Water Research Project

The National Research Council reviewed marine monitoring in 1990, finding that dischargers largely carried out monitoring.[187] The NRC report also found that the monitoring methods were inconsistent with different indicators and field and laboratory methods, and incompatible data formats, making it impossible to synthesize the data to analyze the water quality across the Southern California Bight.[188] In response, the Southern California Coastal Water Research Project (SCCWRP) standardized methods and coordinated data collection.[189] Its first collaborative assessment in 1994 included 12 local, state, and federal agencies and focused on fish and sediment quality.[190] Its second collaborative assessment in 1998 included 62 organizations, and the assessment was expanded to include bays, harbors, port areas, and nearby Mexican waters. It also added a microbiology component.[191] To achieve standardization, SCCWRP developed methods manuals, which now articulate required procedures for monitoring facilities; conducted training exercises; and developed quality assurance protocols involving field audits and blind sample analysis.[192] Today fourteen agencies and organizations participate in SCCWRP, including the most recent addition, the California Ocean Protection Council.[193]

Example: National Water Quality and Assessment Program

The USGS created the National Water Quality Assessment Program (NWQAP) in 1991 in order to provide consistent, long-term data on U.S. water quality, primarily via direct stream analysis. Over the first decade of the program, 51 study units covering nearly half the land mass of the lower 48 states, and accounting for over 65 percent of water use for irrigation and drinking,

185 NOAA Fisheries Information System, Project, *at* http://www.st.nmfs.noaa.gov/fis/about/what.html.

186 InPort—National Fisheries Information System, *About InPort—Description of the InPort System*, *at* https://inport.noaa.gov/inport/about.

187 Brock B. Bernstein and Stephen B. Weisberg, *Southern California's Marine Monitoring System Ten Years After the National Research Council Evaluation*, 81 Envtl. Monitoring & Assessment 3 (2003).

188 *Id.* at 3-4.

189 For a history of the Southern California Coastal Water Quality Research Project, see Mearns, Allen & Moore, *supra* note 137.

190 *Id.* at 20.

191 Bernstein & Weisberg, *supra* note 187 at 4.

192 *Id.* at 5.

193 Southern California Coastal Water Research Project, *About SCCWRP—History*, *at* http://www.sccwrp.org/view.php?id=456.

received intensive cross-disciplinary analysis by USGS teams, leading to the publication of over a thousand reports. In the second decade budget cuts have mandated a reduction to 42 study units, and the NWQA has shifted emphasis to national and regional analysis.[194] The program attempts to balance the goal of comparability, achieved through uniform sampling and analytical methods, with that of precision, achieved by tailoring analysis to the particular characteristics of each Study Unit.[195] Past NWQA work has focused on establishing a reliable baseline on stream and watershed conditions, which has been disseminated through partnerships with over 1,500 stakeholder organizations and agencies.[196]

4.3. Develop regional information systems.

Rationale: One of the major challenges with regional ecosystem science is the lack of a common source of information. There are no comprehensive ecological, social, and economic databases that can be used to inform management decisions. In addition to lacking an appropriate database of information, data collection and storage that supports EBM decisions is rarely standardized across researchers or agencies. This makes the creation and maintenance of a searchable database difficult at best.

Example: Regional Information—Chesapeake Information Management System

Among the requirements of the 1983 Chesapeake Bay Agreement was coordination of technical matters and sharing of data among participating parties, including in the development of management plans.[197] In 1996, the Program developed a publicly available repository of coordinated information through the Chesapeake Information Management System (CIMS).[198] The CIMS-run Chesapeake Bay Program website includes modeling tools and data sets created by the now well-established Chesapeake Bay Program research apparatus, as well as serving as a repository of useful information from outside sources for use by planners and conservation professionals.[199] It also features a wide range of less technical materials for the general public.

194 U.S. Geological Survey [hereinafter USGS], National Water Quality Assessment Program: Entering a New Decade of Investigations, Fact Sheet No. 071-01 at 5 (2001), *available at* http://pubs.usgs.gov/fs/fs-071-01/pdf/fs07101.pdf.

195 Robert J. Gilliom, William M. Alley & Martin E. Gurtz, *Design of the National Water Quality Assessment Program: Occurrence and Distribution of Water-Quality Conditions*, USGS Circular 1112, *available at* http://pubs.usgs.gov/circ/circ1112/introduction.html.

196 USGS, The National Water Quality Assessment Program: Informing Water resource Management and Protection Decisions 6, *available at* http://water.usgs.gov/nawqa/xrel.pdf.

197 1983 Chesapeake Bay Agreement, *available at* http://www.chesapeakebay.net/pubs/1983ChesapeakeBayAgreement.pdf.

198 Chesapeake Bay Program, Adoption Statement on Strategy for Increasing Basin-wide Public Access to Chesapeake Bay Information (1996), *available at* http://archive.chesapeakebay.net/pubs/532.pdf.

199 Chesapeake Bay Program, *Data and Tools*, *at* http://www.chesapeakebay.net/dataandtools.aspx?menuitem=14872.

Example: National Information Center—Digital Coast

NOAA Coastal Services Center leads the Digital Coast effort with extensive input from its partners, including the Coastal States Organization and the National Association of Counties. The Digital Coast is focused on centralizing useful tools and information. It is intended to serve as a repository of data, tools, models, and training for coastal decision-makers.[200] One of its main features is the Legislative Atlas, which maps the limits and boundaries of federal and state area-based laws onto GIS maps.[201] In the future, NOAA CSC intends to expand the datasets and models beyond NOAA sources.

200 NOAA, Coastal Services Center, *Digital Coast Details*, *at* http://www.csc.noaa.gov/digitalcoast/about.html.

201 Matt Freeman, *NOAA's GIS-Enabled Web Site Helps Resource Managers Navigate Legislation*, ARCWATCH (Dec. 2007) http://www.esri.com/news/arcwatch/1207/noaa.html.

IV. ACCOUNTABILITY & ADAPTIVE MANAGEMENT

A. Accountability and Adaptive Management in Brief

Effective ecosystem-based management implementation requires that institutions participate in and are held accountable to the regional programs. These regional programs also must be held accountable to higher levels of government and ultimately to the communities that they represent.

Closely tied to accountability is the need to have a management system that adapts to new information and changing conditions. This chapter addresses both accountability and adaptive management—cross-cutting issues that appear throughout the Handbook. It revisits and references some information previously presented, and adds additional examples and insight.

Institutions participating in regional ocean governance often lack a clear legal mandate or the authority to achieve their region-wide objectives. Instead these institutions look to sector-based laws, regulations, and policies to provide the basis for participation in regional governance programs. This may lead to conflicting objectives, lack of incentive, or inability to implement the EBM objectives established by the regional governance body. This section examines different approaches for creating accountability and establishing obligations for participation in regional governance programs.

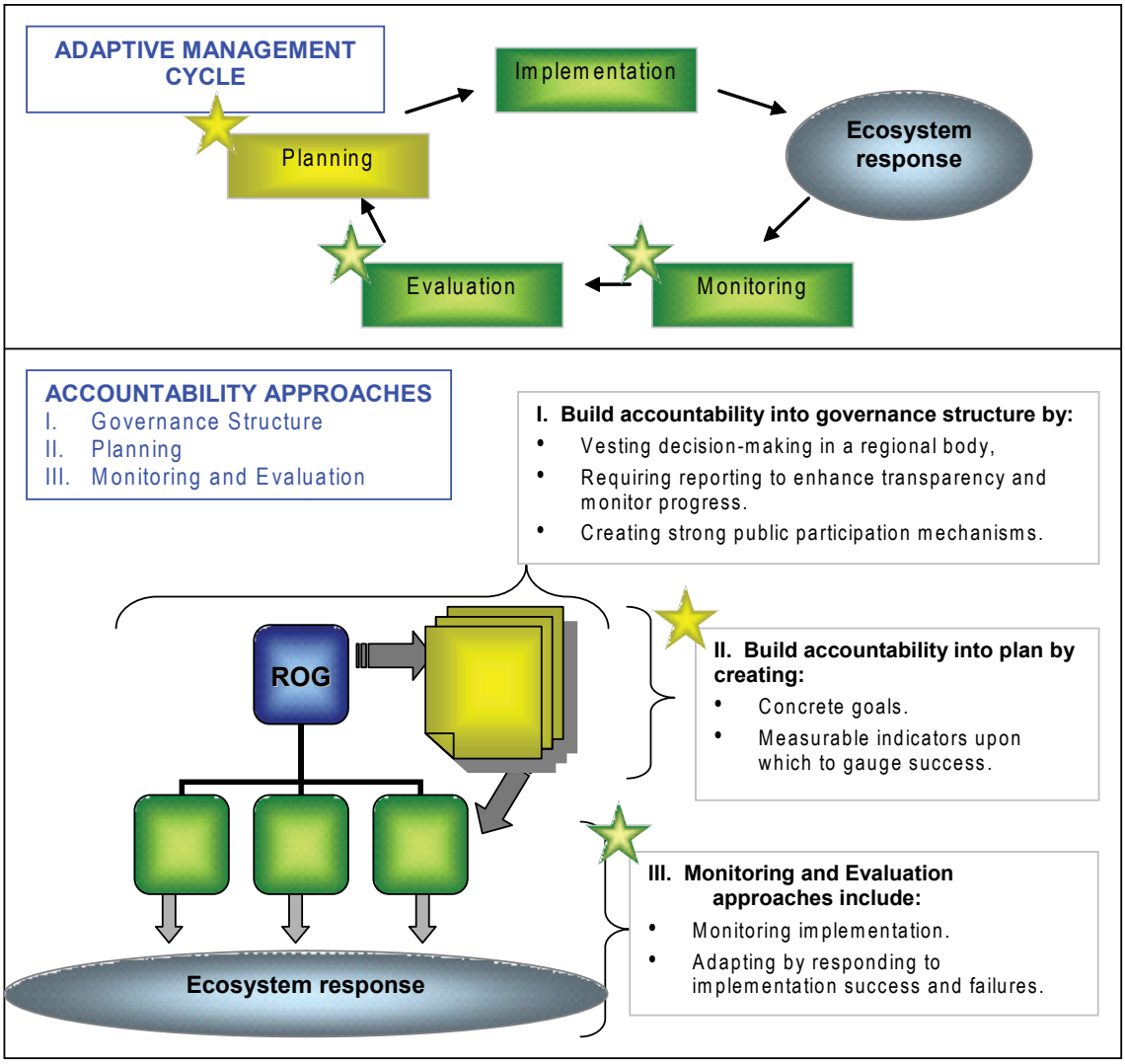
Due to the wide range of stakeholders involved in varying aspects of marine management, both individual actors and institutions can be held accountable for implementation of ecosystem-based plans. For this reason, mechanisms to increase accountability in ecosystem-based planning can be categorized more easily as either legal or non-legal methods. Accountability mechanisms that strive to achieve compliance among the regulated community and state and local governments can generally be divided into two main categories: a deterrence-based approach that induces compliance through legal obligations, or "the sticks;" and a compliance-based approach that offers a range of incentives in an effort to increase cooperation, or "the carrots."[202]

Adaptive management involves testing management approaches, evaluating the effectiveness of different approaches, and making adjustments to management approaches based on outcomes

202 David Markell, *'Slack' in the Administrative State and Its Implications for Governance: The Issue of Accountability*, 84 Or. L. Rev. 1 (2005).

and lessons learned.[203] This section does not cover all aspects of adaptive management. Instead, it focuses on adaptive management as it relates to EBM governance and accountability. Of chief importance to accountability are planning, monitoring, and evaluation.

Figure 9. Accountability and Adaptive Management Mechanisms[204]



The adaptive management cycle (adapted from Ehlers (2003)) show the five essential steps of this iterative management approach. This cycle can be linked by color to the accountability diagram—noting that both the regional ocean governance body and implementation institutions may engage at each step of the adaptive management process.

203 For a list of adaptive management resources, see CAMNet, *Resources and Abstracts Pertaining to Adaptive Management, at* http://www.adaptivemanagement.net/resources.php.

204 Adaptive management diagram, adapted from Charles N. Ehler, *Indicators to Measure Governance Performance in Integrated Coastal Management*, 46 Ocean & Coastal Mgmt 335 (2003).

The accountability approaches described are divided into three categories:

(1) Governance structure

- Mandate EBM.
- Adopt an adaptive management framework.
- Vest decision-making authority in regional body.
- Create strong public participation mechanisms.

(2) Planning requirements

- Create concrete goals and objectives.
- Create measurable indicators.

(3) Implementation approaches

- Evaluate implementation success.
- Require reporting.
- Create incentives to participate in program and implement plans and repercussions for implementation failures.

B. Accountability and Adaptive Management in Practice

1. Governance Structure

1.1. Mandate EBM.

Rationale: Two challenges of a voluntary soft-law EBM program are the inability to require participation of essential institutions and the inability to hold participating institutions accountable to the program. One way to create these obligations is to mandate critical elements of EBM and require implementation. Some states have taken steps to mandate EBM and like ecosystem approaches by enacting state laws. The existing state approaches vary in their implementation requirements and the types of approaches they take to achieve accountability. To date, no federal EBM laws have been passed mandating federal cooperation with EBM implementation.[205] However, federal laws such as the Coastal Zone Management Act offer insight into the creation of a federal EBM system.[206]

Example: Building a Plan and Policy on Existing Law—New York Ocean and Great Lakes Ecosystem Conservation Act

New York enacted a short law declaring that the policy of the state "shall be to conserve, maintain and restore coastal ecosystems so that they are healthy, productive and resilient and able to deliver the resources people want and need."[207] The Act lists a set of principles that should guide coastal ecosystem governance,[208] and creates a Conservation Council tasked with, among other things, "[defining] and implement[ing] an adaptive approach building upon existing laws and programs to advance activities that affect coastal ecosystems in order to ensure the coexistence of healthy ecosystems and human activities."[209] It calls upon the Council to integrate and coordinate EBM with existing laws and programs; develop guidelines to achieve the principles and policies; and facilitate regional cooperation and coordination to address complex issues that cross political and jurisdictional boundaries.

205 For an analysis of the need for an EBM mandate, see Heather Leslie, Andrew A. Rosenberg & Josh Eagle, *Is a New Mandate Needed for Marine Ecosystem-Based Management?* 6 Frontiers Ecol. & Envt. 43 (2008).

206 *See* ELI, Expanding the Use of Ecosystem-Based Management in the Coastal Zone Management Act (2009), *available at* http://www.eli.org.

207 New York Environmental Conservation Law §14-0103(2) (2006).

208 §14-0103(3).

209 §14-0109.

In addition to these broad EBM objectives, the Act specifically tasks the Council with creating a report to the governor and legislature that defines needed executive and legislative actions, includes a plan, schedule and funding activities to achieve the actions, creates an ocean and coastal resource atlas, and establishes a research agenda, among other things.[210] The report was to be delivered in 2008: currently a draft report is available for public comment. Altogether, New York's law defines a policy that may help agencies focus on EBM objectives more readily. It also requires the Conservation Council to take specific actions toward developing EBM. However, the law falls short of creating a comprehensive EBM program with robust accountability measures.

Example: Developing a Program for Restoration—Puget Sound Partnership

At the outset the law establishing the Puget Sound Partnership recognizes that "[l]eadership, accountability, government transparency, thoughtful and responsible spending of public funds, and public involvement" are needed to achieve a healthy Puget Sound.[211] Like the New York law, the Washington law expresses a vision of EBM in the legislative findings. However, the law expressly states that the Partnership will have neither regulatory authority nor implementation authority over regulatory programs, limiting the breadth of its EBM mandate. Instead, the law creates a Partnership tasked with developing and guiding the implementation of an action agenda to restore the Sound by 2020, allocating funds, providing progress reports, setting priorities and benchmarks, and adopting and applying accountability measures.[212] Some accountability measures are built into the law, including reporting provisions, public participation provisions, planning requirements, and implementation requirements that use incentives and funding to create accountability (see subsequent sections for descriptions).

Example: Developing a New Regulatory Framework—Massachusetts Oceans Act

The Massachusetts Oceans Act goes furthest in establishing a regulatory system for the ocean based upon an ocean plan. It vests decision-making (including regulatory) authority in the state Secretary of Energy and Environmental Affairs. According to the Massachusetts Ocean Act, "[u]pon the secretary's adoption of an ocean management plan, all certificates, licenses, permits and approvals for any proposed structures, uses or activities in areas subject to the ocean management plan shall be consistent, to the maximum extent practicable, with the plan."[213] The Secretary is also vested with the authority to promulgate regulations in order to implement, oversee, and enforce plan development. The regulations must include "provisions for the review of the ocean management plan, its baseline assessment and the enforceable provisions of relevant statutes and regulations at least once every 5 years."[214]

210 § 14-0111.
211 ESSB 5372 § 1(d) (Wash. 2007).
212 § 5(a).
213 Mass Gen. Laws ch. 21A § 4C(e) (2008).
214 § 4C(h).

The ocean management plan also will be incorporated into the existing state coastal zone management plan.[215] By making the ocean plan enforceable through these measures, Massachusetts will have the authority to enforce the plan against federal agencies, state or local government activity conducted with federal assistance, and any activities under a federal license or permit "affecting any land or water use or natural resource of the coastal zone"[216] in accordance with the federal consistency provisions of the CZMA (see next).

Example: Ensuring Federal Consistency—Coastal Zone Management Act

According to the Coastal Zone Management Act, federal agency actions that affect the coastal zone must be consistent with the enforceable policies of the state.[217] The enforceable policies must be identified as part of the state's coastal program, which must be approved by NOAA.[218] This provision provides a legal hook for ensuring federal participation in a state program and compliance with the enforceable policies of the coastal state. It also allows states to pursue legal action for federal agency failure to comply with its enforceable policies.[219]

Example: Mandating State and Federal Cooperation—Atlantic Coastal Fisheries Cooperative Management Act

The Atlantic Coastal Fisheries Cooperative Act is a federal law creating a cooperative interstate management program through the Atlantic States Marine Fisheries Commission.[220] In its findings, Congress recognized that "[b]ecause no single governmental entity has exclusive management authority for Atlantic coastal fishery resources, harvesting of such resources is frequently subject to disparate, inconsistent, and intermittent State and Federal regulation that has been detrimental to the conservation and sustainable use of such resources and to the interests of fishermen and the Nation as a whole."[221] The law requires the Secretaries of Commerce and the Interior to develop and implement a program to support the Fisheries Commission's management efforts.[222] It also creates a process for linking management between state waters and the exclusive economic zone—in the absence of a Magnuson-Stevens Fishery and Conservation Management Act plan, the Secretary of Commerce has the authority to develop a plan that is compatible with a State Fisheries Commission plan.[223]

215 Massachusetts Ocean Act § 23 (referencing MASS GEN. LAWS ch. 21A § 4(A)).
216 16 U.S.C. §§ 1456(c)(1)(A) (2005).
217 §§ 1456(c)(1)(A), 1456(d), 1456(c)(3)(A).
218 §1455(d).
219 For more information about EBM and the Coastal Zone Management Act, *see* ELI, EXPANDING THE USE OF ECOSYSTEM-BASED MANAGEMENT IN THE COASTAL ZONE MANAGEMENT ACT, *supra* note 206.
220 16 U.S.C. § 5101 et seq. (1993).
221 § 5101(a)(3).
222 § 5103(a).
223 § 5103(b).

The statute also creates requirements for the coastal states. It requires the Fisheries Commission to develop fishery management plans, and coastal states must implement and enforce the plan as it pertains to each state.[224] If the Secretary of Commerce finds that a state has failed in its implementation and enforcement responsibility, the Secretary is to declare a moratorium on fishing in the non-complying state's waters until compliance is achieved.[225]

The law, therefore, creates a coordinated interstate and federal program that explicitly determines lead authorities, defines management obligations, and creates a system to address non-compliance. A similar approach could be adopted in the development of a regional EBM law.

1.2. Adopt an adaptive management framework.

Rationale: In order to manage effectively in the face of information gaps, scientific uncertainty, and changing conditions, EBM programs should adopt an adaptive framework.[226] This includes creating an iterative system of planning and implementation; monitoring ecosystem, society, and economic response; evaluating results; and developing or amending the plan and possibly the governance system to address management successes and failures. This section describes overall management frameworks, several elements of which relate directly to specific accountability approaches. For additional information and examples related to adaptive management and planning, *see* Chapter II, Ecosystem Planning, Section 1.3.

Example: Adaptive Management Strategy—Chesapeake Bay Program Action Plan and Puget Sound Partnership Action Agenda

The Chesapeake Bay Program has, over its more than 25 years of existence, adapted to changing conditions and new needs through the development of new plans, strategies, and programs. However, until recently, it has not adopted a specific adaptive management framework. Recently, the Program utilized Kaplan and Norton's Five-Stage Model of Adaptive Management to develop an adaptive management strategy.[227] The five steps include: (1) strategy development; (2) translation of the strategy; (3) plan operations; (4) monitoring and learning; and (5) testing and adapting the strategy. It measures the success of its strategies through the use of "realistic annual targets," which are then communicated using Chesapeake Bay Program "dashboards" (*see* Section 2.3 for a discussion of these indicators).

224 § 5104

225 §§ 5105-5106.

226 For a brief discussion of EBM and adaptive management, see McLeod et al., *supra* note 1; *see also* Heather M. Leslie & Karen L. McLeod, *Confronting the Challenges of Implementing Marine Ecosystem-Based Management* 5 Frontiers Ecology & Envt (2007).

227 Chesapeake Bay Program, *Chesapeake Adaptive Management Model*, *at* http://cap.chesapeakebay.net/management-model.htm (citing Robert S. Kaplan & David P. Norton, *Mastering the Management System*, Harvard Business Review (2008).

In Priority E of its Action Agenda, the Puget Sound Partnership identifies the need for a performance management system that "includes adaptive management, coordinated monitoring, accountability for action, and coordinated data management."[228] The Partnership strives to strengthen accountability by assessing progress, ensuring implementation, and adjusting efforts in order to improve effectiveness.[229] The Puget Sound Partnership plans to adopt a "Plan/Do/Assess/Adapt framework," using targets and benchmarks developed by the Science Panel to determine how to enhance future efforts. Through the use of this framework, the Partnership also aims to increase transparency.[230]

1.3. Vest decision-making authority in a regional body.

Rationale: Vesting decision-making authority in a regional body is another legal mechanism that holds the potential to strengthen accountability. This approach could increase transparency and openness, as well as improve consistency and coordination. In an analysis of potential marine zoning in California, Sivas and Caldwell note, however, that stripping agencies of their historical authority may lack political viability.[231]

Example: Commission Authority—Delaware River Basin Commission

Created by state compact in 1961, the Delaware River Basin Commission is tasked with developing and effectuating a river basin plan, allocating water resources among the state signatories, assessing rates and charges on resources users, and approving or denying projects that may impair water resources or conflict with the comprehensive plan.[232] The jurisdiction of the Commission includes the designated river basin and areas outside the basin when "necessary or convenient to effectuate its powers and duties within the basin."[233] Before establishment of the Commission, 43 state agencies, 14 interstate agencies, and 19 federal agencies exercised authority in a fragmented manner.[234]

228 Puget Sound Action Agenda, *supra* note 26 at 70.
229 *Id.* at 71.
230 *Id.* at 72.
231 Deborah A. Sivas & Margaret R. Caldwell, *A New Vision for California Ocean Governance: Comprehensive Ecosystem-Based Marine Zoning*, 27 Stan. Envtl. L.J. 209 (2008). In addition, the authors argue that reducing the number of decision-making entities may reduce the incorporation of accumulated technical, scientific, and policy expertise. Standardization of the guidelines used by each agency may be a way to attain a more comprehensive and coordinated system, without resorting to reduction of agency authority.
232 Delaware River Basin Compact, Art. 3.
233 Art. 2.7.
234 Delaware River Basin Commission, *DRBC Overview*, *at* http://www.state.nj.us/drbc/over.htm.

Example: Agency Oversight Authority—Massachusetts Ocean Management Initiative

While the Massachusetts Oceans Act does not vest all ocean decision-making authority in one regional body or agency, it does give the Secretary of Energy and Environmental Affairs oversight, coordination, and planning authority.[235] It is the Secretary's responsibility to work in consultation with an ocean advisory commission and ocean science advisory council to develop the ocean management plan.[236] The Secretary is tasked with promulgating regulations to implement, administer and enforce the law.[237] All certificates, licenses, permits, and approvals for uses, structures, and activities must be consistent with the plan.[238] In this way, a single agency is held responsible for both plan development and ensuring its implementation.

Example: Sector-Based Authority—California Marine Life Protection Act

Since 1870, the California Fish and Game Commission has played a role in the management of the state's fish and wildlife resources. Under the Marine Life Protection Act, the Commission must approve a master plan that guides implementation of the Marine Life Protection Program, decisions affecting new marine protected area sites, and major modifications to existing marine protected areas.[239] In addition to adopting a master plan, the Commission is responsible for implementing the program, to the extent that funds are available.[240] The Commission must also consider and act upon petitions from any interested party seeking to add, delete, or modify marine protected areas.[241]

While the Commission is vested with the authority to approve and implement the master plan, the California Fish and Game Department is responsible for preparing the plan.[242] The Department must convene a team to assist with plan development.[243] The Department must additionally hold workshops in each biogeographical region in order to incorporate the views of residents and interested parties.[244] In this way, the Department is responsible for plan development, while the Commission is vested with the authority for plan approval and implementation. This process is well-underway in California.

235 Mass. Gen. Law ch 21 § 4C(a) (2008).
236 § 4C(a).
237 § 4C(g).
238 § 4C(e).
239 Cal. Fish & Game Code, § 2855 (2004).
240 § 2859.
241 § 2861.
242 § 2855.
243 § 2855.
244 § 2857.

1.4. Create strong public participation mechanisms.

Rationale: Public opinion, whether it is positive or negative, can be a powerful motivator in promoting accountability. Public opinion is often a driving force behind the actions of both government and industry, and can help generate the political will necessary to inspire action. Considering the wide range of stakeholders with a vested interest in sustainability of the marine environment, public opinion holds the potential to create both short-term and long-term changes in policy implementation and accountability.

Along with reporting (described above), another approach to achieving accountability is the inclusion of public comments in the planning and decision-making process. Involving the public can ensure that institutions account for stakeholder interests, and it creates greater transparency and openness. Notice and comment can happen at several stages of EBM governance—during the development of the regional governance system (e.g., Puget Sound Partnership), development of regional plans (e.g., Massachusetts Ocean Partnership), and implementation of regional plans through sector-specific agencies (e.g., federal fisheries regional councils).

Citizen suits are legal mechanisms that typify the "sticks" approach to accountability. Private citizens can either sue people alleged to be in violation of regulatory obligations, or they can sue government agencies alleged to have failed to perform mandatory duties.245 Citizen suits against government agencies have resulted in changes ranging from the creation of entirely new regulatory programs to a shift in focus, significant expansion, or accelerated implementation of existing regulatory programs. Citizen suits publicize the shortcomings of government agencies, compelling these institutions to act responsibly even absent a potential lack of political will or popularity.

Example: Connecting via the Internet—"Thank You Oceans" Campaign

New web-based tools are changing how governing bodies communicate with the public. Internet tools such as blogs, email listservs, podcasts, and social networking sites provide new avenues to connect ocean governance with the public, helping to achieve better accountability through information-sharing. California's "Thank You Oceans" Campaign, while not EBM-specific in focus, provides one example of using technology to communicate with the public.[246] The Campaign's purpose is "to instill in Californians a sense of personal connection and responsibility to our ocean and coast."[247] Any member of the public can join the listserv, which

245 Robert Glicksman, *The Value of Agency-Forcing Citizen Suits to Enforce Nondiscretionary Duties*, 10 Widener L. Rev. 353 (2004).
246 ThankYouOcean.Org, About ThankYouOcean.Org, *at* http://www.thankyouocean.org/about.
247 *Id.*

sends out announcements about ocean-related government decisions, conservation issues and opportunities, and general ocean information. By website and listserv it announces the availability of various podcasts—ranging from a status report on the health of the red abalone population to announcements about how the public can get involved with volunteer activities at the National Marine Sanctuaries Program.

Example: Participation throughout the Process—Puget Sound Partnership and California Marine Protected Area Network

Before creation of the permanent Puget Sound Partnership under state law, Washington's Governor created a Partnership Advisory Commission by executive order to develop recommendations for a permanent Partnership. During development of the recommendations leading to the state law, the Partnership included public participation and comments, which were included in the final report presented to the Governor.

With the creation of the permanent Partnership, focus has shifted to developing an Action Agenda. To help develop the Agenda, the Partnership first identified six goals, and held topic forums on these issues. Small groups of science and policy experts helped frame the discussion by developing discussion papers. The papers were utilized to engage topic forum participants and online public reviewers. The comments will be included in the action plan agenda appendix and will inform the Action Agenda's development.[248] Once created, the public will have access to the Action Agenda.[249] The public also will have an opportunity to participate at the implementation stage, providing input in the development of standards and processes with which to measure the success of Action Agenda implementation.[250]

The California Marine Life Protection Act (MLPA) tasked the California Department of Fish and Game with preparing a plan for establishing an integrated system of protected areas and a coordinated management strategy.[251] It directed the Department to convene a master plan team, composed of scientists and state agency representatives, so as to best include the scientific expertise on marine protected areas in the new plan.[252] It also required that the plan be "prepared with the advice, assistance, and involvement of participants in the various fisheries and their representatives, marine conservationists, marine scientists, and other interested persons," including specific state and federal agencies.[253]

248 Puget Sound Partnership, Action Agenda: Meetings and Workshops, *at* http://www.psp.wa.gov/aa_meetings_past_tf.php.
249 ESSB 5372 § 13(5) (Wash. 2007).
250 § 17(2).
251 Cal. Fish & Game Code, § 2855 (2004).
252 § 2855(b).
253 § 2855(b)(4).

After failed attempts to initiate the program, in August of 2004, the Department of Fish and Game, California Resources Agency, and the Resources Legacy Fund began a new effort, referred to as the MLPA Initiative, to implement the Marine Life Protection Act.[254] The initiative divided the state into five study regions to be addressed independently rather than addressing the state as a single unit.[255] In light of this structure, the initiative established a blue-ribbon task force composed of public leaders selected by the California Resources Agency to oversee the regional projects, prepare recommendations for coordinating marine protected area management with federal agencies, and direct expenditure of initiative funds.[256] The initiative also established master plan science advisory teams for each study region.[257] These teams are composed of the state agency representatives and scientists required by the MLPA and are tasked with providing the scientific knowledge and judgment needed to complete and implement the master plan.[258] Additionally, the initiative established regional stakeholder advisory groups, composed of individuals selected by the Director of the Department of Fish and Game, to provide local knowledge to the planning and implementation process.[259]

The MLPA Initiative has a four-step process for implementing the Marine Life Protection Act.[260] First, the regional stakeholder groups and science teams must develop regional profiles, convene regional planning processes, and identify alternative approaches to marine protected area networks in their respective regions.[261] Second, after evaluating new and existing marine protected areas, each regional stakeholder group must develop alternative packages of marine protected areas for its region.[262] Third, the blue-ribbon task force evaluates these proposals, identifies a preferred alternative, and submits all proposals to the California Fish and Game Commission.[263] The Commission then will prepare regulatory analyses of the proposals.[264]

Example: Public Forums and Meetings—Massachusetts Ocean Management Initiative and California Ocean Protection Council

Under the Massachusetts Oceans Act, the Secretary of Energy and Environment Affairs is required to hold public meetings related to the ocean management plan and to provide public access to the draft plan in electronic and printed form.[265] In response to this requirement the Secretary hosted 18 public forums to incorporate public comments during plan development

254 Cal. Dept. of Fish & Game, California Marine Life Protection Act: Revised Master Plan for Marine Protected Areas 9 (2008).
255 *Id.* at iii.
256 *Id.* at 15.
257 *Id.* at 16.
258 *Id.*
259 *Id.*
260 *Id.* at iii.
261 *Id.*
262 *Id.*
263 *Id.*
264 *Id.*
265 Mass. Gen. Law §§ 4C(c)(ii), (g).

and intends to host another series of meetings once the plan is finalized.[266] Likewise, under the California Ocean Protection Act, the Ocean Protection Council must make its meetings open to the public.[267] In addition, the Council has the authority to sponsor conferences, symposia, and other public forums to seek public input.[268]

Example: Sector-Based Public Participation—Fishery Management Councils

In accordance with the Magnuson-Stevens Act, the fisheries management councils conduct public hearings to allow for public comments on fishery management plans, amendments to such plans, and their implementing regulations.[269] Within 45 days of the close of a 60-day public comment period, the Secretary, in consultation with a given Council, must analyze the comments and publish the final regulations. The public must also be provided opportunity to comment on the administration of the plans.[270]

Example: Citizen Suit Provisions—Endangered Species Act

Citizen suit provisions in federal and state statutes usually provide any person the right to file suit against government agencies and possibly private parties for violating the law. Such provisions give the public a direct role in the enforcement of laws and therefore create a strong accountability mechanism. To date, no state EBM laws contain citizen suit provisions. However, citizen suits under the Endangered Species Act (ESA) provide an example of enforcement of accountability that could be applied more broadly in the implementation of ecosystem-based planning.[271] Under Section 11(g), "any person may commence a civil suit on his own behalf" against private parties and overseeing federal agencies for violations of the Act. This includes the ability to file suit against the government for failure to perform non-discretionary duties.[272] This provision along with the creation of mandatory deadlines was added to the Act by Congress in 1982 due to concern about the slow pace of listing decisions.[273] Such an approach could be applied in the EBM context: an EBM law could include a citizen suit provision that would allow citizens to help enforce EBM plans.

266 For more information, *see* Massachusetts Ocean Coalition, *at* http://www.massoceanaction.org/; *see also* Massachusetts Office of Coastal Management, The Massachusetts Ocean Management Initiative, *at* http://www.mass.gov/czm/oceanmanagement/index.htm.

267 Cal. Pub. Res. Code. § 35612(a) (2004).

268 § 35612(b).

269 MSA, § 313; 16 U.S.C. § 1862 (2007).

270 § 304; § 1854.

271 For a general summary of the Endangered Species Act, *see* Pamela Baldwin, Eugene H. Buck & M. Lynne Corn, *The Endangered Species Act: A Primer*, CRS Report for Congress Order Code RL31654, *available at* http://www.enviro-lawyer.com/ESASummary.pdf.

272 Endangered Species Act, § 11(g)(C); 16 U.S.C. § 1540(g)(C) (2000).

273 Sarah Matsumoto et al., Citizen's Guide to the Endangered Species Act (2003), *available at* http://www.earthjustice.org/library/reports/Citizens_Guide_ESA.pdf.

2. Planning Requirements

This section overlaps considerably with the Chapter II, Ecosystem Planning but focuses more narrowly focuses on the relationship of goals, objectives, and indicators to developing an accountable system of EBM governance.

2.1. Create concrete goals and objectives.

Rationale: One step in the system of adaptive management that is critical for accountability and often overlooked, is the evaluation stage of the iterative management cycle. However, to be able to evaluate a management program's success, it is first necessary to have a plan of action that includes concrete goals and measurable objectives to allow evaluation.[274] Preferably, at least some of the measurable objectives will be quantitative in nature.

For additional information, *see* Chapter II, Ecosystem Planning, Section 4 for discussion.

Example: Land Use Goals and Objectives—Chesapeake Bay Program

Chesapeake 2000 recognized the role that sound land use plays in watershed health and EBM in general. One of its stated goals was to "develop, promote and achieve sound land use practices which protect and restore watershed resources and water quality, maintain reduced pollutant loadings for the Bay and its tributaries, and restore and preserve aquatic living resources." More specific methods by which to achieve this goal were detailed, one of which was the acquisition and permanent preservation from development of 20 percent of the land area in the watershed by 2010. This amounted to 6.92 million acres – and as of July 2007, 6.88 million acres had been preserved.[275]

Example: Management Goals and Objectives—Gulf of Mexico Alliance

The Gulf of Mexico Alliance created the Implementation Activities Matrix to express the implementation strategy for the Action Plan. The Matrix lists the specific goals and outcomes described in the Action Plan and also has a column—"What will you do/deliver?"—that describes concrete actions that will achieve the goal and outcome. For example, one of the water quality goals is to improve government efficiency. To achieve this goal, one specific activity is to host an annual Gulf of Mexico Forum. The column of specific commitments states that EPA

274 Charles N. Ehler, *Indicators to Measure Governance Performance in Integrated Coastal Management*, 46 Ocean & Coastal Mgmt 335 (2003); Nugent & Profeta, *supra* note 13 at 6.

275 Chesapeake Bay Program, Chesapeake Bay Health and Restoration Assessment: A Report to the Citizens of the Bay Region 27 (2007), *available at* http://www.chesapeakebay.net/content/publications/cbp_26038.pdf.

will co-lead and co-sponsor the event and that Mississippi will participate and provide in-kind support.[276]

Example: Invasive Species Goals—Gulf of Maine Council

The Gulf of Maine Council identifies long-range, mid-term, and short-term outcomes in its Action Plan to create accountability and to help measure progress in achieving its ultimate goals. For example, the Council has a goal of protecting and restoring habitats, which includes the objective of addressing invasive species. One stated short-term (few years) goal is for coastal lawmakers to have an increased understanding of the marine invasive species threats. One mid-term (several years) goal is for regulators to take legal approaches to minimize adverse impacts of invasive species. And the expressed long-term (more than a decade) goal is to minimize the adverse effect of marine invasive species on the coastal environment.

Example: Legal Basis for Concrete Goals and Objectives Development—Puget Sound Partnership

Washington State vested the Puget Sound Partnership with responsibility for developing an action agenda that would "[prioritize] necessary actions, both basin-wide and within specific areas, and [create] an approach that addresses all of the complex connections among the land, water, web of species, and human needs. The action agenda will be based on science and include clear, measurable goals for the recovery of Puget Sound by 2020."[277] Specifically, the action agenda must include "measurable outcomes for each goal and objective specifically describing what will be achieved, how it will be quantified, and how progress towards outcomes will be measured. The action agenda shall include near-term and long-term benchmarks designed to ensure continuous progress needed to reach the goals, objectives, and designated outcomes by 2020" and "identify the agency, entity, or person responsible for completing the necessary strategies and actions, and potential sources of funding."[278]

Example: Legal Basis for Indicator Development—Massachusetts Oceans Act

In planning for Massachusetts' coastal development, the Massachusetts Oceans Act requires that "[t]he plan shall: (i) set forth the commonwealth's goals, siting priorities and standards for ensuring effective stewardship of its ocean waters held in trust for the benefit of the public."[279]

276 Gulf of Mexico Alliance, Implementation Activities Matrix, *supra* note 79.
277 ESSB 5372 §§ 1, 2(a) (Wash. 2007).
278 §§ 12, 13.
279 Mass. Gen. Law ch 21A § 4C(d) (2008).

2.2. Create measurable indicators.

Rationale: Measurable indicators should be designed to allow evaluation of the program's success at achieving its concrete goals and measurable objectives. The Organization for Economic Cooperation and Development lists two main requirements for indicators (1) that they should "[r]educe the number of measures which normally would be required for an exact presentation of a situation;" and (2) that they "[s]implify the process of communication to managers, stakeholders and communities."[280]

Four main types of indicators are (1) input indicators related to resources allocated to the goal; (2) process indicators; (3) output indicators indicating deliverables to the program; and (4) outcome indicators demonstrating on-the-ground results.[281] Indicators should relate to environmental results as well as socioeconomic results.[282]

For a list of examples and descriptions, see Chapter II, Ecosystem Planning, Section 4.3, "include specific indicators to measure success," which includes the following examples:

- ***Fisheries Indicators—The Chesapeake Bay***, describing the development of indicators from a single-species approach to ecosystem-based fisheries management approach.
- ***Water Quality Indicators—The Everglades***, describing water quality indicators used to measure the progress of restoration efforts in the Everglades.
- ***Land Use Indicators—Gulf of Maine Council***, describing the development of indicators for point sources, employment densities, population densities, and impervious surfaces as a way to measure mitigation of coastal development impacts.
- ***Management Indicators—MPA Guidebook***, providing a process for selecting indicators and listing biophysical, socioeconomic, and governance indicators.

280 Robert E. Bowen & Cory Riley, *Socio-Economic Indicators & Integrated Coastal Management*, 46 Ocean & Coastal Mgmt 299 (2003) (citing the Organization for Economic Cooperation and Development).

281 Ehler, *supra* note 274 at 337.

282 Bowen & Riley, *supra* note 280. See Bowen & Riley for a table of socio-economic indicators. *Id*. at 307.

3. Implementation Approaches

3.1. Evaluate implementation success.

Rationale: The adaptive management cycle includes evaluation of implementation success. The purpose of evaluation, as described by Ehler (2003), is to use the information gathered to (1) improve management performance and (2) as a way to create accountability in the program.

Example: Chesapeake Bay Realistic Annual Targets and Dashboards

Part of the Bay Program's adaptive management approach is "realistic annual targets," which provide both an evaluation of the success in reaching a quantifiable objective and a projection of upcoming annual achievements toward the goal. The Bay Program uses the "dashboards" to communicate these results and provide information about why the program is succeeding or missing its targets as a way of informing the public. The Bay Program's submerged aquatic vegetation (SAV) efforts provide one example of this adaptive approach. Its current measurable objective is to plant 1,000 acres of new SAV beds between 2003 and 2008 in accordance with the plan, *Chesapeake 2000*. The realistic annual targets indicate the level of success and future realistic estimates of progress. As of 2007, the Program had achieved 14 percent of this goal (140 acres of new SAV beds) and intends to achieve 16 percent of this goal by 2009 (160 acres).[283] The SAV planting dashboard provides a one-page easy-to-understand public document mapping performance in relation to the actual objective, providing a brief strategic analysis including challenges and actions needed, and a summary of project funding.[284]

283 For a complete list of realistic annual targets, *see* Chesapeake Bay Program, *Goals, Measures and Progress*, *at* http://cap.chesapeakebay.net/progress.htm.

284 Chesapeake Bay Program, Submerged Aquatic Vegetation Planting, CAP Version 1.0 (2008), *available at* http://cap.chesapeakebay.net/docs/SAVFinalv2.pdf.

3.2. Require reporting.

Rationale: One mechanism for achieving accountability in EBM is through reporting requirements. These requirements can be enforced through a legal mandate or could be instituted through a voluntary agreement. Reporting requirements can apply to a regulated entity (e.g., grantee reports to regional governance body), to an institution (e.g., sector-based agency report to regional governance program), or to the regional governance program (e.g., reports to the legislature(s) or to the public). Internal reporting allows the EBM program to evaluate the effectiveness of plan and program implementation. External reporting helps link EBM programs to the larger political process and to the public, creating an external accountability mechanism. The effectiveness of reporting requirements, though, often depends upon establishing meaningful indicators for evaluating success as described in the previous section.

Example: Internal Reporting—Puget Sound Partnership

According to Washington state law, "[a]ny entity that receives state funds to implement actions required in the [Puget Sound Partnership] action agenda shall report biennially to the council on progress in completing the action and whether expected results have been achieved within the time frames specified in the action agenda."[285]

Example: External Reporting to Governor and Legislature—Puget Sound Partnership

According to state law, the Puget Sound Partnership must report to the Governor and the state legislature every two years through a State of the Sound Report. The report must include the following elements:

> (a) An assessment of progress by state and nonstate entities in implementing the action agenda, including accomplishments in the use of state funds for action agenda implementation;
> (b) A description of actions by implementing entities that are inconsistent with the action agenda and steps taken to remedy the inconsistency;
> (c) The comments by the panel on progress in implementing the plan, as well as findings arising from the assessment and monitoring program;
> (d) A review of citizen concerns provided to the partnership and the disposition of those concerns;
> (e) A review of the expenditures of funds to state agencies for the implementation of programs affecting the protection and recovery of Puget Sound, and an assessment of whether the use of the funds is consistent with the action agenda; and

285 ESSB 5372 § 16 (Wash. 2007).

> (f) An identification of all funds provided to the partnership, and recommendations as to how future state expenditures for all entities, including the partnership, could better match the priorities of the action agenda.[286]

The Science Panel must separately comment on the state of ecosystem health and on the current understanding of the science of the Sound and useful strategies.

Example: Independent Review—Puget Sound Partnership

In addition to the Puget Sound Partnership's biennial State of the Sound Report, the state law creates an independent system of review. According to the law, the Joint Legislative Audit and Review Committee (JLARC) must review the Partnership's implementation of the Action Agenda in 2011. JLARC will also conduct two performance reviews in 2011 and 2016, which will include:

> (a) A determination of the extent to which funds expended by the partnership or provided in biennial budget acts expressly for implementing the action agenda have contributed toward meeting the scientific benchmarks and the recovery goals of the action agenda; (b) A determination of the efficiency and effectiveness of the partnership's oversight of action agenda implementation, based upon the achievement of the objectives as measured by the established environmental indicators and benchmarks; and
> (c) Any recommendations for improvements in the partnership's performance and structure, and to provide accountability for action agenda results by action entities.[287]

Example: External Report—Chesapeake Bay Health Report Card

The Chesapeake Ecocheck program, a collaboration between NOAA and the University of Maryland, develops an annual report card that rates 15 regions using six indicators to determine an index of overall health, water quality and biota. The six indicators focus on water quality including water clarity, chlorophyll *a*, dissolved oxygen and biotic health including the benthic community, aquatic grasses, and the phytoplankton community. In addition to rating each region, the report card rates the overall health of the Bay. The report card includes a map with the identified grades, regional rankings and summaries, comparisons, and trends. For example, in 2007, the overall Chesapeake Bay received a C-. The Upper West Shore of the Bay received the highest grade, a B, and the York River and Patuxent River tied for low scores with D-. The report describes the Upper Western Shore as being greatly improved due to aquatic grasses, benthic community and chlorophyll *a* conditions but notes that the health of this region varies greatly by year. In contrast, the York River experienced declines in chlorophyll *a*, aquatic grasses, and the benthic community and received its lowest score since 1991.

286 § 19.
287 § 21.

3.3. Create incentives to participate in the program and implement plans and establish repercussions for implementation failures.

Rationale: Bringing regional constituents together, developing a plan, and implementing that plan are all challenges to achieving successful EBM. Ensuring implementation of a regional plan is central to the issue of accountability. Several examples exist of well-developed plans that fall short of implementation objectives. Developing appropriate incentives are one way to encourage implementation.[288] Such incentives linked to appropriate repercussions for failure could bolster accountability to regional plans.

Example: Funding, Implementation Support, and Public Engagement—Puget Sound Partnership

The state law creating the Puget Sound Partnership includes several accountability mechanisms. It allows the Leadership Council to "hold management conferences with implementing entities to review and assess performance in undertaking implementation strategies."[289] If the Leadership Council finds inconsistency with the Action Agenda it has the authority to support and assist the implementing entity in order to remedy the inconsistency.[290] If substantial noncompliance is found, the Leadership Council is required to provide notice of this finding and the Executive Director or the Council must work with the entity to remedy the non-compliance. In the event a remedy is not found, the Council is to hold a public hearing to present its findings and proposed actions. If the entity still does not comply, the Council must issue written findings and has the authority to recommend that the entity be ineligible for state financial assistance until noncompliance is remedied.[291]

The Washington law creates accountability through financial incentives and disincentives. The law states that projects and activities that are incompatible with the action agenda are not to be funded and that funding should strategically targets priority action agenda items.[292] The Partnership is tasked with providing funding for Puget Sound restoration and is required to ensure accountability in expenditure of the funds.[293] Fund recipients must utilize the funds in a way that is most consistent with action agenda priorities. The Partnership may also suspend funds or create conditions for future funding if the funds were not spent in a manner consistent with the grant obligations.[294]

288 *See* Nugent and Profeta, *supra* note 13 for a brief discussion of the need for federal incentives to illicit meaningful participation in an EBM program.
289 ESSB 5372 § 17(2) (Wash. 2007).
290 § 17(2).
291 § 17(3).
292 § 16(1).
293 § 15(2).
294 § 15(3).

V. CUMULATIVE IMPACTS

A. Cumulative Impacts In Brief

Scientific understanding of marine ecosystems and the direct and indirect impacts of human activities is expanding rapidly.[295] Without good scientific information, accurately predicting the consequences of cumulative impacts—i.e. added activities, multiple activities, or repetitive activities—on particular ecosystems can be difficult. While this is one of the greatest obstacles to identifying and minimizing human impacts on marine ecosystems, it is not the only one.

Marine economic sectors are largely regulated independently, making cross-sector evaluations and ecosystem management complicated. In most sectors, sustainable limits on pollution and resource extraction are poorly defined. Additionally, few federal or state laws require explicit consideration of cumulative impacts, and among those that do, the depth and breadth of analysis are limited. Finally, guidelines for setting comprehensive but practical boundaries for cumulative impacts analyses have yet to be developed.

EBM is more than a restructured governance system. It is a management approach that seeks to minimize human impacts to the marine environment that result in loss of the ecosystem services upon which humans depend. In the EBM scientific consensus statement, scientists state that "[e]cosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; ***it considers the cumulative impacts of different sectors***."[296] In this context, "cumulative impacts" refers to the net effect of all human activities—a broader definition than the typical legal definition that considers cumulative impacts as those impacts that are alone insignificant but together equate to a significant impact.

Effective management of the marine environment should do more than *consider* cumulative impacts. Consideration of cumulative impacts should lead to decisions that minimize these impacts and allow marine ecosystems to remain healthy and resilient. The impacts of human activity on the environment do not occur in isolation. A single action may have minor consequences on a marine ecosystem but still have a significant cumulative impact when combined with the effects of other actions. This impact may be "additive," where a small addition triggers a noticeable change due to the accumulation of prior additions; or "synergistic," where the separate impacts combine to create an altogether different effect on the environment than any single activity.[297] In either case, a critical component of ecosystem-based management

295 *See, e.g.,* Halpern et al., *Global Map*, *supra* note 4.

296 McLeod et al., *supra* note 1 (emphasis added).

297 For a discussion of types of cumulative impacts, *see* Benjamin S. Halpern et al., *Managing for Cumulative Impacts in*

is identifying the many human impacts, understanding their effects on the ecosystem, and minimizing them so that all ecosystem services are maintained.

As this Handbook shows, many regional governance programs in the U.S. are based on soft-law agreements (e.g., memoranda of understanding, governors' statements, and joint aspirational documents), and that the programs tend to be advisory and informational in nature.[298] Existing regional governance programs often focus on broad policies, restoration of disturbed environments, education and outreach, and development of ecosystem data. There are often disconnects between regional governance programs and the regulatory agencies that are making day-to-day and project-by-project permitting and licensing decisions. However, it is precisely these individual projects that occur across sectors, over time, and throughout the ecosystem that cumulatively impact and destroy the environment.[299]

One way that government agencies manage ecosystems is by managing the activities of the people who use them. Several approaches are possible. Some activities may take place in the absence of any regulatory framework. More often, government agencies regulate human uses through the use of a permit system. In other cases, laws and policies may be designed to encourage certain behaviors or activities through incentive-based programs. And some locations may be completely protected and off-limit to all human uses, while some activities may be completely prohibited no matter the location.

Figure 10 provides a framework for how government can consider and minimize cumulative impacts caused by human use. Government can prevent human use by preserving the natural environment through designation of parks and protected areas (Fig. 10(A): this has been a traditional conservation approach. Government can minimize human use to maintain sustainability by prohibiting some activities or limiting activities in certain places or at certain times, by encouraging sustainability through education and incentives, or by regulating human use through permits and licenses to ensure sustainability (Fig. 10(B)).[300] A third approach, which should be the last resort but is often the typical course of action, is to restore the environment only after degradation has occurred (Fig. 10(C)). Because destructive human impact to the marine environment is ultimately the challenge that EBM attempts to overcome, the full suite of approaches for addressing cumulative impacts should be employed in order to achieve and maintain healthy and resilient marine ecosystems.

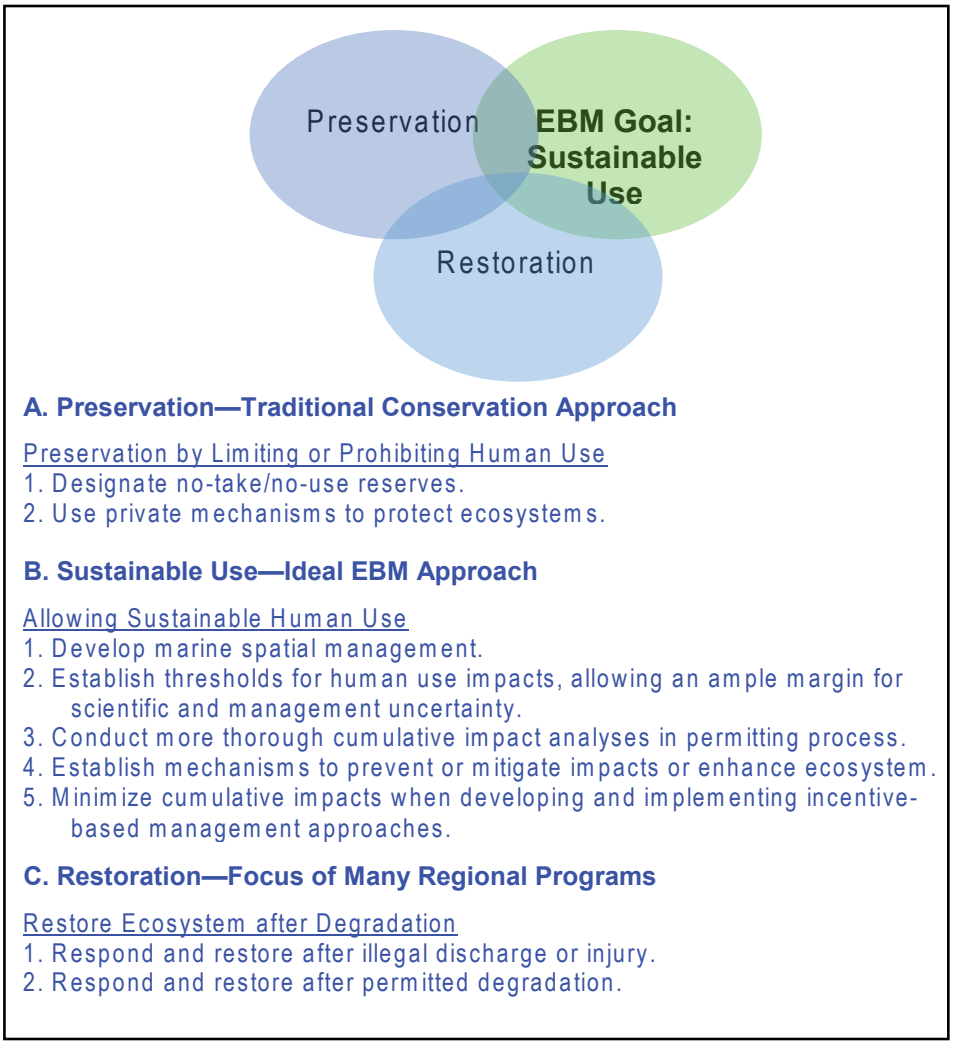
Ecosystem-Based Management through Ocean Zoning [hereinafter *Cumulative Impacts*], 51 OCEAN & COASTAL MGMT 203, 204-205 (2008) (designating within-activity human impacts (more than one of the same activity) as not cumulative, accumulative, and fully additive and multiple human activities as dominant, additive, multiplicative, and mitigative).

298 ELI, EBM LAWS AND INSTITUTIONS, *supra* note 16.

299 Halpern et al., *Global Map*, *supra* note 4.

300 For a discussion of the elements and challenges of achieving sustainable use, *see* Jon M. Hutton & Nigel Leader-Williams, *Sustainable Use and Incentive-Driven Conservation: Realigning Human and Conservation Interests*, 37 ORYX 215 (2003).

Figure 10. Approaches to Addressing Human Impacts



Because of ecosystem complexity and the enormous pressure to utilize resources, managing sustainable use (Fig. 1(B)) is one of the most daunting challenges for EBM implementation. At its heart is the need to allow human use but also to control it so that the environment maintains important ecological functions that allow maintenance of the full suite of services upon which humans and other species depend.

In addition, the existing regulatory regime in the U.S. exacerbates the problem of managing for sustainable use. ELI's review of cumulative impact assessments, case law, and current ocean health all point to a permitting and licensing system that does not effectively analyze and minimize cumulative impacts.[301]

301 *See, e.g.,* Michael D. Smith, *Recent Trends in Cumulative Impacts Case Law* (on file with authors), describing the cumula-

Typically, permitting and licensing agencies determine on a project-by-project or case-by-case basis whether an activity will be permitted, not permitted, or permitted if certain conditions are met. For example, the Federal Energy Regulatory Commission determines whether companies can develop wave energy projects in the territorial seas. The U.S. Army Corps of Engineers determines whether dredge-and-fill operations can take place in navigable waters. The U.S. Environmental Protection Agency (EPA) or the states determine whether industry can discharge pollutants into water bodies or the air. These and other agencies make determinations of permitted or licensed use based on individual substantive laws like the Clean Water Act, the Clean Air Act, the Federal Power Act, and corresponding state laws, and based on procedural requirements under the National Environmental Policy Act (NEPA) and state NEPAs (including the California Environmental Quality Act, or CEQA).

Recent academic publications and state law and policy changes have focused on preservation and sustainable use (Figure 1(A), (B)) by designating protected areas and implementing ocean zoning approaches that prohibit or limit uses in all or some areas.[302]

Some laws such as NEPA or CEQA explicitly require consideration of cumulative impacts, but these laws do not have detailed provisions fleshing out this requirement. Under NEPA, federal agencies generally have two available guidance documents—(1) a 1997 Council on Environmental Quality handbook on cumulative impact analysis, and (2) the EPA handbook related to analysis under the Clean Air Act. There is no federal guidance that specifically addresses cumulative impact assessments for the marine environment. In short, there is very little legal and regulatory meaning to the term "cumulative impacts." It is perhaps not surprising then that the resulting analysis often falls far short of what is required or possible.

tive impact assessments under NEPA. The author, for example, states that a study of 89 environmental assessments found that only 35 of those even mentioned cumulative impacts and only half of those provided any evidence of analysis.

302 *See, e.g.,* Halpern et al., *Cumulative Impacts*, *supra* note 297; Sivas & Caldwell, *supra* note 231; California Marine Life Protection Act; Massachusetts Oceans Act.

B. Cumulative Impacts In Practice

1. Preservation by Limiting or Prohibiting Human Use

1.1 Designate marine no-take or no-use reserves.

Rationale: Often viewed as necessary but not sufficient for the proper management of marine resources, marine reserves are "areas of the ocean completely protected from all extractive and destructive activities," allowing only for activities necessary for monitoring and research.[303] Area-based preservation has long been an approach to conservation in the terrestrial environment. Marine reserves both limit human impact within the reserve and help address cumulative impacts beyond the reserve. In addition to protecting habitat and species in the protected areas, marine reserves can help the recovery of a broader population and can serve as baseline research sites to inform the management of the broader ecosystem.[304]

Marine reserves may occur in isolation (e.g., Papahānaumokuākea Marine National Monument) or as a network of reserves (e.g., California Marine Life Protection Act). Also, the establishment of marine reserves may be part of a larger comprehensive ocean zoning scheme. This section focuses on marine reserves or reserve networks. The broader concept of ocean zoning—one that more fully aligns with EBM objectives—is described in the subsequent section.

Example: State-Based Approach—California Marine Protected Area Network

The California Marine Life Protection Act (MLPA) instructs the California Department of Fish and Game to prepare a master plan for the adoption and implementation of a Marine Life Protection Program, including a network of marine protected areas that range in their level of protection throughout state waters.[305] A draft of the master plan was completed in August of 2005 and revised in January of 2008. The development of a statewide network of marine protected areas currently is underway.[306]

303 Jane Lubchenco et al., *Plugging a Hole in the Ocean: The Emerging Science of Marine Reserves*, 13 Ecological Applications S3 (2003).
304 *Id.* at S3.
305 Cal. Fish & Game Code §§ 2855, 2859 (1999).
306 Cal. Dept. of Fish & Game, Marine Life Protection Act Initiative, *at* http://www.dfg.ca.gov/mlpa/.

The Marine Life Protection Act identifies six specific goals for the Marine Life Protection Program: protect the diversity of marine life and integrity of marine ecosystems; help rebuild, sustain, and protect marine life populations; improve recreational, educational, and study opportunities from minimally-disturbed ecosystems; protect marine life habitats unique to and representative of California's marine natural heritage; ensure that the state's marine protection areas have clear objectives, effective management, adequate enforcement, and are based on sound science; and ensure that state marine protected areas are designed and managed, to the extent possible, as a network.[307]

The Marine Managed Areas Improvement Act of 2000 identifies three classifications of marine protected areas: state marine reserve, state marine park, and state marine conservation area.[308] State marine reserves are the most protected areas, open for research and non-consumptive human use only when consistent with the protection of all marine resources.[309] State marine parks allow certain uses, including recreational harvesting, so long as it does not compromise the protection of species of interest, habitat, or geologic or cultural features.[310] In state marine conservation areas, the managing agency may permit commercial as well as recreational harvesting, but with similar caveats to those of state marine parks.[311]

Example: Sector Specific Protection—Alaska Habitat Conservation Zones

Individual sectors can successfully protect habitat from the activities of that sector. For example, in an effort to protect sensitive habitat and support sustainable fisheries, NOAA Fisheries issued a rule closing large areas of Alaska seafloor to bottom-contact fish gear. These marine protected areas comprise relatively undisturbed habitats where only limited fishing occurs,[312] and thus preserve relatively healthy ecosystems. Located in the Aleutian Islands and the Gulf of Alaska, the closed areas contain seafloor and coral habitats that are readily damaged and slow to recover from fishing activities.

Of these marine protected areas, the Aleutian Island Habitat Conservation Area prohibits bottom trawling in an area of approximately 280,000 square nautical miles.[313] The Bowers Ridge Habitat Conservation Zone prohibits mobile bottom-tending fish gear within this area of the islands.[314] Six Aleutian Island Coral Habitat Protection Areas preserve especially sensitive coral gardens by prohibiting all bottom-contact fishing. In the Gulf of Alaska, ten Habitat

307 Cal. Fish & Game Code § 2853(b) (2000).
308 Cal. Pub. Res. Code § 36700 (2004).
309 § 36710(a).
310 § 36710(b).
311 § 36710(c).
312 NOAA, National Marine Protected Areas Center, Federal Agency Report under Executive Order 13158 on Marine Protected Areas, Fiscal Years 2005-2006 12-13, *available at* http://www.mpa.gov/pdf/helpful-resources/fedagency_rpt_05-06.pdf.
313 *Id.*
314 NOAA Fisheries, Press Release, August 8, 2005, *available at* http://www.fakr.noaa.gov/newsreleases/2005/efhrod080805.htm.

Conservation Areas along the continental slope protect hard bottom habitat essential to rockfish. In addition, the Gulf of Alaska has five Coral Habitat Protection Areas and fifteen Seamount Habitat Protection areas closed to bottom-contact fish gear.[315]

While this approach has the effect of protecting large ocean areas from the chief impacting industry, this approach is limited—the restrictions only apply directly to the fisheries sector. These restrictions may lead to other federal agencies consulting about potential uses that affect these areas in accordance with the Magnuson-Stevens Fishery Conservation and Management Act essential fish habitat provisions. However, the essential fish habitat provisions only trigger consultation, and not substantive action, by other federal agencies.

Example: Federal Approach—Florida Keys National Marine Sanctuary and Papahānaumokuākea Marine National Monument

The objective of the National Marine Sanctuaries Act (NMSA) is to designate as sanctuaries, and protect, restore, and enhance, those areas of the marine environment that are of special significance.[316] The NMSA authorizes the Secretary of Commerce to designate these marine protected areas if the discrete area is special due to "its conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities … the communities of living marine resources it harbors; or … its resource or human-use values."[317] Additionally, the existing state and federal authorities must be otherwise inadequate to ensure coordinated conservation, and the discrete area must be large enough to allow for comprehensive management.[318] The Secretary of Commerce has the authority to "issue such regulations as may be necessary to carry out" the NMSA,[319] thus permitting and prohibiting certain uses. The NMSA is unique in its comprehensive marine management authority as it can cover state and federal waters.[320]

The Florida Keys National Marine Sanctuary is one of thirteen sanctuaries administered under the NMSA with the most comprehensive zoning scheme among the sanctuaries.[321] The Florida Keys Sanctuary management plan attempts to reduce user conflicts and protect critical habitats and species by designating five types of marine zones, each with a different level of protection.[322] These include the following:

315 NOAA, National Marine Protected Areas Center, *supra* note 312 at 12-13.
316 16 U.S.C. § 1431(b) (2000).
317 § 1433(a).
318 § 1433(a).
319 § 1439. However, the Secretary may not terminate any lease, permit, or license existing on the date of the designation. § 1434(c)(1).
320 § 1432(3).
321 The Florida Keys National Marine Sanctuary and Protection Act, Pub. L. No. 101-605, 104 Stat. 3089 (1990).
322 NOAA, Florida Keys National Marine Sanctuary Revised Management Plan 6 (2007).

- Sanctuary Preservation Areas are sited in shallow, heavily used reefs facing resource degradation from concentrated visitor traffic and user conflicts. Regulations for these areas limit consumptive activities that threaten resource protection. There are eighteen Sanctuary Preservation Areas totaling approximately 6.5 square nautical miles.
- Ecological Reserves are sited in spawning, nursery, and permanent-residence areas critical to the replenishment of fish and other marine life. Here all consumptive activities are prohibited, and non-consumptive activities are permitted only if they are compatible with protection objectives. There are two Ecological Reserves in the Sanctuary totaling 160 square nautical miles.
- Special-Use Areas are restricted to permitted entry for the purpose of research and education, recovery of degraded resources, or preventing user conflicts. The four permanent Special-Use Areas are designated for research only.
- Wildlife Management Areas are sited around the habitats of sensitive or endangered wildlife for the purpose of protecting them while providing for limited, if any, public use. There are 27 such Areas in the Sanctuary, 20 of which are co-managed with the U.S. Fish and Wildlife Service.
- Existing Management Areas cover the resource management areas already in existence, whether state or federal, prior to the first Sanctuary management plan; there are 21 such Areas.[323]

In the 2001 evaluation of the comprehensive management plan, the Sanctuary Advisory Council found that this zoning structure had been highly effective, with many areas showing "positive biological change inside their boundaries after just a short period of protection."[324]

Despite considering only marine activities and leaving much of the Sanctuary unzoned, this zoning program makes modest strides toward addressing cumulative impacts. The plan is focused on outcomes, primarily the protection of marine resources while accommodating human uses. The areas for zoning are selected based on their ecological significance, and the type of zone for any one area depends on the impact from human activity that area can withstand. Those activities that may have too great an impact are limited or prohibited in the area. This reduces the cumulative impact of multiple sectors or multiple users in a single sector in that zone. But, this may concentrate human activity outside the delineated zones, possibly resulting in greater cumulative impacts in the unzoned regions.

In Presidential Proclamation 8031, President George W. Bush designated approximately 140,000 square miles of emergent and submerged lands and waters of the Northwestern Hawaiian Islands as a national monument under the 1906 Antiquities Act. The Antiquities Act "authorizes the president, in his discretion, to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon

323 *Id.* at 142-143.
324 *Id.* at 142.

lands owned or controlled by the Government of the United States to be national monuments."[325] The Papahānaumokuākea Marine National Monument includes the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, the Midway Atoll National Wildlife Refuge, the Hawaiian Islands National Wildlife Refuge, and the Battle of Midway National Memorial.[326] The Secretary of Commerce has primary responsibility for managing the marine protected areas, and the Secretary of the Interior manages monument areas that overlap with the Midway Atoll National Wildlife Refuge, the Battle of Midway National Memorial, and the Hawaiian Islands National Wildlife Refuge. Additionally, the Secretary of Commerce and the Secretary of the Interior review and modify the interagency agreement to coordinate management of the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, if appropriate.[327]

The proclamation prohibits most activities, including exploring for or producing oil, gas, or minerals within the monument; anchoring a vessel on coral; introducing nonnative species or discharging any material; and swimming, snorkeling, or scuba diving within a special preservation area or the Midway Atoll Special Management Area.[328] Commercial fishing for "bottomfish and associated pelagic species" may continue until 2011. However, total landings may not exceed 350,000 pounds of bottomfish and 180,000 pounds of pelagic species. After 2011, fishing for these species is prohibited within the monument.[329] Owners of vessels containing operating vessel monitoring systems additionally must be issued a permit to access the monument.[330] The proclamation also allows for Native Hawaiian practice permits and special ocean use permits upon meeting designated criteria.[331]

1.2. Use private mechanisms to protect ecosystems.

Rationale: Private mechanisms—including purchasing conservation easements, acquiring leases, and purchasing property in fee simple—can be used to preserve specific areas from all or some human uses. Chief challenges to applying private mechanisms in the ocean and coastal environment include (1) the cost of coastal property and (2) the inability to lease or purchase submerged lands or ocean areas for conservation purposes. Despite these limitations, private mechanisms are available and are being used for targeted preservation in some regions.

325 Proclamation No. 8031, 71 Fed. Reg. 36,443 (June 26, 2006).
326 *Id.*
327 *Id.*
328 *Id.*
329 *Id.*
330 *Id.*
331 *Id.*

Example: Federal Purchasing Program—NOAA Coastal and Estuarine Land Conservation Program

Established in 2002, NOAA's Coastal and Estuarine Land Conservation Program (CELCP) provides matching funds to states to purchase coastal and estuarine lands and obtain conservation easements from private parties.[332] To date, this program has distributed approximately $200 million in 26 states, protecting more than 35,000 acres of land.[333] The lands are to have "significant conservation, recreation, ecological, historical, or aesthetic value[], or … are threatened by conversion from their natural or recreational state to other uses."[334] NOAA has developed guidelines for distributing funds, which allow states with approved coastal zone management plans or National Estuarine Research Reserves to participate in the program.[335] The state must have an approved Coastal and Estuarine Conservation Plan before submitting an application to the competitive grant program.[336] Lead state agencies have the opportunity to redistribute funds via grants to other state agencies, local governments or other eligible entities in accordance with Coastal Zone Management Act Section 306A(e).[337] States can use CELCP funds for developing CELCP plans ($50,000), program administration, acquisition, and a small amount for initial land stewardship costs.[338]

Example: State-Based Protection Program—California Coastal Conservancy

The California Coastal Conservancy was established in 1976 to "purchase, protect, restore, and enhance coastal resources, and to provide access to the shoreline."[339] In accordance with state statute, the Conservancy can acquire coastal lands, issue grants to state agencies to acquire land or water areas of sensitive resource value, and issue grants to nonprofit organizations to acquire lands in accordance with statutory requirements.[340] Since the creation of the Conservancy, it has helped to preserve more than 300,000 acres of coastal habitat.[341] In 2008, the Conservancy awarded more than $102 million to support 147 projects along the coast—part of which was for property acquisition. It used these funds to leverage additional funds from the federal government and private organizations worth more than $178 million. Much of the funding used by the Conservancy came from state bonds acts approved by California voters.

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332 NOAA, Ocean & Coastal Resources Management, *The Coastal and Estuarine Land Conservation Program*, *at* http://coastalmanagement.noaa.gov/land/welcome.html.

333 NOAA, Ocean & Coastal Resources Management, *Overview of NOAA's Coastal and Estuarine Land Conservation Program (CELCP)*, *at* http://coastalmanagement.noaa.gov/land/welcome.html.

334 33 U.S.C. § 1456(d) (2002).

335 NOAA, Ocean & Coastal Resources Management, *Coastal & Estuarine Land Conservation Program: Final Guidelines* 4 (2003), *available at* http://coastalmanagement.noaa.gov/land/welcome.html.

336 *Id.*

337 *Id.* at 5.

338 *Id.* at 5-6.

339 California Coastal Conservancy, *About the Conservancy…*, *at* http://www.scc.ca.gov/index.php?cat=1.

340 Cal. Pub. Res. Code. §§ 31105, 31115, 31116.

341 California Coastal Conservancy, *2008 Project Accomplishments*, *at* http://www.scc.ca.gov/index.php?cat=21.

Example: Private Mechanisms for Marine Protection—The Nature Conservancy's Marine Conservation Agreements

The Nature Conservancy (TNC) is leading NGO efforts to conserve and protect the marine and coastal environment using proprietary mechanisms. It has developed the *Practitioner's Toolkit for Marine Conservation Agreements*, which provides strategies and approaches for using private mechanisms to protect ocean and coastal resources.[342] TNC defines marine conservation agreements as "any formal or informal understanding between two or more parties in which the parties obligate themselves, for an exchange of benefits, to take certain actions, refrain from certain actions, or transfer certain rights and responsibilities to achieve agreed upon ocean or coastal conservation goals…. MCAs can be entered into by governments, communities, private entities (including not-for-profit and for-profit), and private individuals."[343] TNC provides a large list of examples from efforts throughout the world. U.S. examples include:

- Purchasing coastal property and leasing submerged lands in California's Richardson Bay in California for the creation of a wildlife sanctuary;
- Leasing submerged land in Puget Sound, Washington, for a native oyster habitat restoration program;
- Kelp bed leases in California to harvest kelp and research kelp removal effects on biodiversity;
- Annual authorization to undertake eelgrass restoration on 205 acres of submerged land in Narragansett Bay, Rhode Island; and
- Purchase of three islands including property rights in the intertidal lands in Virginia to form the Virginia Coast Reserve.

A limitation of this approach is that there are few property rights available for conservation purposes in the U.S. marine environment, especially in federal waters. Private parties can obtain permits and leases for extraction from state and federal governments. However, there are few instances in the U.S. of being able to utilize those mechanisms to preserve the ocean environment.

342 The Nature Conservancy, *Marine Conservation Agreements: A Practitioner's Toolkit*, *available at* http://www.leaseown.org/.

343 *Id.*

2. Allowing Sustainable Human Use

2.1. Develop marine spatial management.

Rationale: Marine spatial planning is a strategic, proactive means of "regulating, managing and protecting the marine environment, including through allocation of space that addresses the multiple, cumulative, and potentially conflicting uses of the sea."[344] In essence, this planning process identifies existing and potential future demands on ocean resources, both human and non-human, and attempts to balance these demands, and their effects, in a sustainable manner by designating preferred uses in specific geographic areas. Spatial planning and zoning require up-front costs and the process for comprehensive zoning is complex. However, once completed spatial planning and zoning can simplify the process of predicting and minimizing the cumulative impacts within and across sectors.

Ocean zoning, often the result of marine spatial planning, is the implementation of regulatory measures governing the permissible uses, if any, in defined geographic zones of ocean waters.[345] This form of managing marine resources can reduce cumulative impacts as compared to a more ad hoc system by considering such impacts in the planning process and incorporating that information into the zoning plan. But by widening the scope of these planning and managerial processes to include defined terrestrial areas, more factors that contribute to marine degradation can be managed together, thus magnifying the benefits.

The following section identifies a variety of laws and programs designed to unify planning and management of the marine ecosystem, some more comprehensive than others but each with a unique approach to a similar end.

Example: Coastal Management—Alaska Coastal Management Program

The federal Coastal Zone Management Act (CZMA) established a voluntary program in the Department of Commerce that offers cost-sharing grants to coastal states, including U.S. territories and Great Lakes states, to develop and implement coastal zone management programs.[346] In addition to these grants, the CZMA encourages participation in the program by authorizing the federal government to delegate "federal consistency review" authority to states

344 Marine Spatial Planning Pilot Consortium, Marine Spatial Planning Pilot: Final Report 1 (2006), *available at* http://www.defra.gov.uk/science/Project_Data/DocumentLibrary/ME1407/ME1407_3296_FRP.pdf.

345 United Nations Educ., Sci. & Cultural Org., *Marine Spatial Management: Introduction*, *at* http://www.unesco-ioc-marinesp.be/introduction.

346 16 U.S.C. §§ 1453(1), 1455(a), 1455b(f) (2005).

with approved coastal management programs, allowing states to approve or reject proposed federal actions depending on whether they are consistent with the enforceable policies of the state's program.[347]

Alaska developed its Coastal Management Program (ACMP) in 1977 with the objectives of balancing the use and protection of coastal resources; managing, restoring, and enhancing the quality of the coastal environment; and developing "commercial enterprises that are consistent with the social, cultural, historic, economic, and environmental interests of the people of the state."[348] Authority under the ACMP is shared between the state and 33 local coastal resource districts.[349] The Alaska Department of Natural Resources is the lead agency, responsible for adopting statewide standards for establishing coastal zone boundaries, determining the land and water uses subject to the ACMP, developing policies and regulations applicable to those uses, designating and developing policies for coastal areas that merit special attention, developing policies and procedures for permitting in coastal areas, and measuring the success of coastal resource districts.[350]

The coastal resource districts, by contrast, have authority to add specificity to the statewide standards. The designated mechanism for exercising that authority is a district coastal management plan.[351] The management plan must be based on a comprehensive plan or statement that governs the use of resources in the coastal area.[352] The management plan must meet statewide standards and include boundaries of the district coastal area, a list of land and water uses subject to the plan, policies applicable to these uses, descriptions of proper and improper uses, and the designation of and development of policies for coastal areas that merit special attention.[353] Including local government in the coastal management process promotes the integration of coastal management with other local planning concerns, as exemplified by the fact that most cities with coastal districts add consistency requirements to their land use regulations.[354] Local districts may establish specific coastal boundaries, so long as they extend inland and seaward enough to manage a use or activity that is likely to significantly affect coastal waters and so long as it includes intertidal areas, beaches, islands, saltwater wetlands, salt marshes, and any other areas vulnerable to sea level rise.[355]

The zoning that results from the ACMP is not comprehensive, insofar as it does not necessarily designate allowable uses for all state marine waters. But in many cases it identifies permissible

347 §§ 1454, 1456(c)-(d).
348 Alaska Stat. § 46.40.020.
349 § 46.40.210(2).
350 § 46.40.040(a)(1).
351 § 46.40.030(a).
352 § 46.40.090.
353 § 46.40.030(a).
354 Jeffrey H. Wood, *Protecting Native Coastal Ecosystems: CZMA and Alaska's Coastal Plain,* 19S Nat. Resources & Env't 57, 60 (2004).
355 Alaska Admin. Code tit. 11 § 114.220(c).

and impermissible uses for specific areas and outlines priority of uses for those areas.[356] Furthermore, the ocean zoning that results from the ACMP could be made more comprehensive under the existing legal structure. What sets the ACMP apart from the other ocean zoning programs in the U.S. is two-fold: (1) the inclusion of terrestrial areas and activities and (2) the extent to which local governments are involved in the zoning process. These two factors are interrelated, as control over terrestrial zoning primarily rests in the hands of local governments; inclusion of local governments in the planning process may improve efficiency and effectiveness of the land-based regulations and makes coastal management more holistic. The ACMP offers an example of how this integration may be accomplished.

Example: Coastal Zone Management—Rhode Island Ocean Special Area Management Plan

Rhode Island is using the CZMA in a unique manner to accomplish its ocean zoning objectives. The CZMA creates a funding mechanism for the development of Special Area Management Plans (SAMPs), defined as "a comprehensive plan providing for natural resource protection and reasonable coastal-dependent economic growth containing a detailed and comprehensive statement of policies; standards and criteria to guide public and private uses of lands and waters; and mechanisms for timely implementation in specific geographic areas within the coastal zone."[357]

In early 2008, the Rhode Island Coastal Resources Management Council (CRMC) proposed the development of a SAMP focused on offshore renewable energy. The SAMP is intended to comprehensively zone a roughly 36-by-25 nautical mile stretch of ocean off the coast of Rhode Island that includes most, if not all, state marine waters as well as federal waters.[358] The development of the Ocean SAMP will be divided into two parts. First, the CRMC will prepare a zoning map for offshore waters within the predetermined area that will identify the location of certain uses, including energy facilities, that present environmental concerns and potential conflicts.[359] Second, the CRMC will create design and construction rules for the offshore energy production projects.[360] The SAMP is expected to be completed in 2010.[361]

By identifying current and expected uses of those ocean waters, ecologically sensitive and significant areas, and the windiest stretches of that region, the SAMP is expected to define preferred sites for offshore wind development, among other uses.[362] The CRMC has experience

356 *See, e.g.*, Haines Borough Enforceable Policies, Sitka Coastal Management Plan Enforceable Policies and Definitions, Valdez Enforceable Policies and Designated Areas, *available at* http://www.alaskacoast.state.ak.us/Explore/alldistEPS.html.
357 16 U.S.C. § 1453(17) (2005).
358 Timothy C. Barmann, *Mapping the Ocean: SAMP Will Target Areas for Renewable Energy Projects*, Providence J. (July 24, 2008), *available at* http://www.projo.com/news/content/bz_ocean_samp18_07-24-08_8BAT7HN_v13.31a3bbf.html.
359 *Id.*
360 *Id.*
361 R.I. Coastal Res. Mgmt. Council & Univ. of R.I., The Ocean/Offshore Renewable Energy Special Area Management Plan i (2008).
362 *Id.*

with SAMP development, having adopted four SAMPs and currently working on two others.[363] But the Ocean SAMP is different as it does not pertain to a "specific geographic area[] within the coastal zone;" rather, it applies to substantially more area than that encompassed by just state waters.

According to the CRMC, the Ocean SAMP structure serves several purposes.[364] First, the SAMP is intended to "streamline cumbersome federal and state permitting processes and establish a more cost-effective permitting environment for investors."[365] The CRMC believes that the Ocean SAMP will meet its requirements for scientific analysis and planning, including stakeholder involvement, as well as those requirements of the MMS, the ACOE, NOAA, and the Rhode Island Department of Environmental Management.[366] Second, the CRMC seeks to "promote a balanced approach to considering the development and protection of ocean-based resources."[367] A SAMP is intended to "provid[e] for natural resource protection and reasonable coastal-dependent economic growth,"[368] thus supplying a sound foundation and process for this balanced approach. Third, the CRMC aims to "complete the necessary studies to yield the most accurate and current ocean-based scientific data and technologies to build knowledge critical for supporting the permitting process."[369] SAMPs often are resource-intensive, including substantial scientific data-gathering. Fourth, the CRMC wishes to "foster a well-informed and committed public constituency." Perhaps more than any of the three aforementioned goals, this one is well suited for a SAMP. Effective SAMPs generally "provide for appropriate, timely, meaningful stakeholder and public participation in the development and implementation of the plan,"[370] which informs the public and encourages their commitment to its objectives.

The CRMC also intends to use the SAMP as a means of collaborating with federal agencies. Effective SAMPs often include "a strong commitment and willingness at all levels of government to enter into a collaborative planning process to produce enforceable plans."[371] This cooperative approach in the Ocean SAMP is intended not only to streamline permitting procedures later, but also to effectively expand the planning area past state waters.[372]

Since Rhode Island does not have authority beyond its three miles of state waters, any planning for federal waters would require cooperation from relevant federal agencies to have any effect.

363 Barmann, *supra* note 358.
364 *See* R.I. Coastal Res. Mgmt. Council & Univ. of R.I., *supra* note 361.
365 *Id*. at 1.
366 *Id*.
367 *Id*.
368 16 U.S.C. § 1453(17) (2005).
369 R.I. Coastal Res. Mgmt. Council & Univ. of R.I., *supra* note 361 at 1.
370 NOAA, *In Depth: Understanding Special Area Management Plans*, *at* http://coastalmanagement.noaa.gov/issues/special_indepth.html.
371 *Id*.
372 Personal communication, on file with authors (July 31, 2008).

Example: Marine Spatial Management—Massachusetts Ocean Management Initiative

Massachusetts' Oceans Act of 2008 is the first state legislation to require the development of a comprehensive management plan for marine waters.[373] The objective of the plan is a balance between natural resource preservation and human activity, particularly renewable energy.[374] The ocean management plan is intended to cover all marine waters under the jurisdiction of Massachusetts. According to the Act, the plan shall include any waters and submerged lands of the ocean beginning at the "Nearshore Boundary of the Ocean Management Planning Area" and extending to the seaward boundary of the commonwealth, three nautical miles from shore.[375] The plan also must detail the municipal, state, and federal boundaries and recommend ways to clarify them.[376]

The Act anticipates that the plan will consider and fulfill many state objectives. Among these objectives are the establishment of siting priorities and standards for ensuring protection of marine waters as well as identifying appropriate locations and performance standards for marine activities, uses, and facilities.[377] The plan also is intended to identify and protect sensitive or unique estuarine and marine life and their habitats.[378] It is expected to foster sustainable uses and coordinate activity under international, federal, state, and local authority.[379] In the course of developing these and other aspects of the plan, the secretary must consider the existing natural, cultural, historical, social, and economic characteristics of the regions affected by it.[380]

According to the Oceans Act, once the Secretary of Energy and Environmental Affairs adopts the ocean management plan, "all certificates, licenses, permits and approvals for any proposed structures, uses or activities in areas subject to the ocean management plan shall be consistent, to the maximum extent practicable, with the plan."[381] Furthermore, the secretary must promulgate regulations for implementing, administering, and enforcing the Act.[382]

Since the planning process, let alone the actual plan, is still in its early stages, considerations of cumulative impacts, explicitly or impliedly, are not yet clear. But, the legislative structure of the plan could promote the identification and reduction of cumulative impacts in the zoning process. Not only is the plan intended to protect sensitive marine life and habitats, but the Massachusetts comprehensive management plan is expected to establish siting priorities and identify preferred locations for various marine uses. In the process of making these decisions, the Secretary likely would, and should, consider the direct, indirect, and cumulative impacts of existing and future uses on marine ecosystems. By geographically separating some activities within and across

373 Press Release, The Office of Governor Deval Patrick, Governor Patrick Signs Law Creating First-in-the-Nation Oceans Management Plan Balancing Preservation, Uses (May 28, 2008), *available at* http://www.mass.gov/?pageID=gov3pressrelease&L=1&L0=Home&sid=Agov3&b=pressrelease&f=080528_oceans&csid=Agov3.
374 *Id.*
375 Mass. Gen. Law ch 21A § 4C (2008).
376 § 4C
377 § 4C
378 § 4C
379 § 4C
380 § 4C
381 § 4C
382 § 4C

sectors, strategically managing the density of certain sector activities within an area, and giving the greatest protection to particularly fragile marine environments, the plan could reduce and prevent future cumulative impacts.

2.2. Establish thresholds for human use impacts, allowing an ample margin for scientific and management uncertainty.

Rationale: Determining the thresholds for sustainable levels of extraction or pollution within the context of the full suite of human activities in a region could help address cumulative impacts. Such an approach would include a margin of safety for both causes of uncertainty in permitting: lack of scientific information and imprecise implementation.

Thresholds can be used to ensure that the combined human activities and impacts do not exceed levels that would substantially diminish valuable ecosystem services. By setting a margin of safety, there is less risk that human activity will exceed sustainability thresholds. This section identifies three permitting schemes that determine a maximum level of impact offset by a margin of safety and issue permits based on those figures. Examples included here focus on sector-based or single-impact thresholds, since few if any cross-sector thresholds have been established to date.

Example: A Quantitative Approach to Address Uncertainty about Impact—Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) provides an example of how institutions can take a quantitative approach to account for uncertainty when making decisions related to allowable impacts on resources.[383] However, it should be noted that this is a scientifically intensive endeavor that will only be made more complicated by a cross-sector approach.

After reauthorizing the MSA in 2007, Congress now requires fishery management councils to "establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability."[384] Annual catch limits may not exceed the fishing levels recommended by a fisheries council's Scientific and Statistical Committee.[385] To assist regional fishery management councils in developing annual catch limits and accountability measures, the National Marine Fisheries Service finalized new guidelines

383 16 U.S.C. § 1801 et seq (2007).
384 MSA, §§ 104(a)(10), 303(a)(15) (2007).
385 § 302(h)(6).

in January 2009.[386] Combined, the amended law and new guidelines create a system of tiered reference points that serve to inform total allowable catch and prevent overfishing.

Key quantitative measures include annual catch limits (ACL), accountability measures (AMs), overfishing limits (OFL), acceptable biological catch (ABC), and annual catch target (ACT).[387] The OFL is "an estimate of the catch level above which overfishing occurs."[388] ABC is "a level of a stock or stock complex's annual catch that accounts for the scientific uncertainty in the estimate of OFL and any other scientific uncertainty."[389] ACL is "is the level of annual catch of a stock or stock complex that serves as the basis for invoking AMs. ACL cannot exceed the ABC, but may be divided into sector-ACLs."[390] AMs are management controls used to prevent ACL overage and are divided into in-season AMs (e.g., fishery closures, area closures, changes in trip or bag limits) and AMs for when the ACL is exceeded (e.g., next year overage adjustments and other mitigation measures).[391] Finally ACT is defined as "an amount of annual catch of a stock or stock complex that is the management target of the fishery, and accounts for management uncertainty in controlling the actual catch at or below the ACL."[392]

The final guidance states that the ACT be of equal or lesser value than the ABC, which should be of equal or lesser value than the OFL (i.e. OFL ≥ ABC ≥ ACL).[393] While proposed guidelines stated that the ACT should be equal or less than the ACL, this was dropped in the final guidance and is recommended as part of the accountability measures.[394] These four quantities—OFL, ABC, ACL, and ACT—act as quantitative thresholds that are used to prevent overfishing. The objective of this structure is to account for scientific and management uncertainty so as to prevent, on an annual basis, the ACL from being exceeded.[395]

Example: Creating a Margin of Safety—Clean Water Act

The Clean Water Act (CWA) Total Maximum Daily Load (TMDL) Program provides another example of how to create a margin of safety. TMDLs apply to all pollutant sources, and so are cross-sector in nature. However, they do not directly address the interconnections between multiple pollutants or pollutants combined with other types of human impact. The TMDL

386 Magnuson-Stevens Act Provisions; Annual Catch Limits; National Standard Guidelines,74 Fed. Reg. 3178 (Jan 16, 2009) (to be codified at 50 C.F.R. pt. 600).
387 For a summary of the guidelines, *see* NOAA Fisheries, Office of Sustainable Fisheries, *Revsisions to the National Standard 1 Guidelines: Guidance on Annual Catch Limits and Other Requirements* (Jan 2009)(PowerPoint presentation), *available at* http://www.nmfs.noaa.gov/msa2007/docs/acl_final_ns1_rev_presentation_jan162009.pdf.
388 74 Fed. Reg. 3206.
389 *Id.* at 3208.
390 *Id.*
391 *Id* at 3210.
392 *Id.* at 3209.
393 74 Fed. Reg. 3180. [386]
394 *Id.*
395 *Id*.

program focuses on the impact to waters receiving pollutant discharges. The process leading to the creation of a TMDL begins with state water quality assessments: if a water body or segment does not meet a water quality standard for a designated use, it is deemed to be impaired.[396] If a water segment is impaired by a pollutant[397] and not otherwise exempted, a TMDL must be developed to address the pollutant.[398] A TMDL allocates permissible pollutant loading among types of contributors, up until the point that the water segment would risk falling out of compliance with water quality standards.

Vital to a TMDL is accurate calculation of the loading capacity, the maximum amount of a pollutant that a water body can receive from all contributing sources, in addition to background conditions, without violating water quality standards.[399] This total load is divided among three categories, a wasteload allocation, a load allocation, and a margin of safety. A wasteload allocation is "[t]he portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution."[400] The wasteload allocation for a specific pollutant is divided among the contributing point sources that are regulated under NPDES permits. A load allocation is "[t]he portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources."[401] The combination of load and wasteload allocations must be below the loading capacity to account for "any lack of knowledge concerning the relationship between effluent limitations and water quality."[402] This is the margin of safety. In practice, the margin of safety increases with less-developed predictive models.[403]

While TMDLs allocate based on individual pollutants, a more comprehensive TMDL is not expressly prohibited, and in practice some TMDLs address more than a single pollutant. Also, water quality standards for designated uses, e.g., recreation and fish consumption, suggest a more comprehensive approach to addressing the additive and synergistic causes of impairment. Regardless of whether multiple pollutants are addressed together, ultimately a loading capacity and allocation of loads must be calculated for each pollutant. Thus, a TMDL is more successful in considering the cumulative impacts of multiple sources of the same pollutant than it is in considering multiple pollutants.

396 33 U.S.C. § 1313(d)(1)(A) (2000).

397 The term "pollutant" is defined in the Clean Water Act as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water." § 1362(6).

398 1313(d)(1)(C).

399 40 C.F.R. § 130.2(f).

400 § 130.2(h).

401 § 130.2(g).

402 33 U.S.C. § 1313(d)(1)(C) (2000).

403 *See* EPA, Guidance for Water Quality-Based Decisions: The TMDL Process (1991), http://www.epa.gov/owow/tmdl/decisions/dec2.html.

To date, few saltwater bodies, mostly bays, have been identified as impaired.[404] This may be the result of limited monitoring rather than attainment of water quality standards. Many water quality standards are just as applicable in saltwater as they are in freshwater, and some states have standards exclusively for marine waters. But without monitoring and subsequent impairment designations, TMDLs likely will not be developed for marine waters. Unless this approach changes, TMDLs likely will continue to focus on tributaries, estuaries, and bays but not open ocean waters. Thus, for purposes of marine activities, the TMDL program offers an opportunity for addressing cumulative impacts but has been underutilized in these waters to date.

Example: Classifying Human Use Impacts—Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) places "a moratorium on the taking and importation of marine mammals and marine mammal products."[405] One of the few exceptions to this moratorium is the incidental take of marine mammals in the course of commercial fishing.[406] However, the MMPA has a clear objective of reducing the incidental mortality and serious injury of marine mammals caused by commercial fisheries to insignificant levels approaching zero.[407] To this end, the Secretary of Commerce is tasked with establishing and annually updating a list that classifies commercial fisheries as having (i) frequent incidental mortality and serious injury of marine mammals; (ii) occasional incidental mortality and serious injury of marine mammals; or (iii) a remote likelihood of or no known incidental mortality or serious injury of marine mammals."[408] In order to engage in lawful incidental take of marine mammals in a commercial fishery listed in category (i) or (ii), a vessel must obtain authorization from the Secretary of Commerce.[409]

This authorization may be suspended or revoked if the owner of the vessel fails to comply with a "take reduction plan,"[410] developed and implemented by the Secretary of Commerce and designed to recover or prevent the depletion of marine mammal stocks that interact with a commercial fishery listed in category (i) or (ii).[411] Each take reduction plan must include, among other things, recommended measures for reducing incidental mortality and serious injury.[412] To implement a plan, the Secretary of Commerce may "establish fishery-specific limits on incidental mortality and serious injury of marine mammals in commercial fisheries or restrict commercial fisheries by time or area;" "require the use of alternative commercial fishing gear or techniques

404 *See, e.g.*, Alaska Dept. of Envtl. Conservation, Final Total Maximum Daily Loads in the Waters of Silver Bay, Alaska (2003); N.C. Dept. of Env't & Natural Res., Total Maximum Daily Loads for Fecal Coliform for Jarrett Bay and Its Embayment, North Carolina (2007).
405 16 U.S.C. § 1371(a) (2007).
406 § 1371(a)(2).
407 § 1387(b)(1).
408 § 1387(c)(1)(A).
409 § 1387(c)(3)(A).
410 § 1387(c)(4)(B).
411 § 1387(f)(1).
412 § 1387(f)(4).

and new technologies, encourage the development of such gear or technology, or convene expert skippers' panels;" and "educate commercial fishermen."[413]

Important to a take reduction plan is an estimation of the potential biological removal level for each stock. This level is "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population."[414] For those stocks that exceed the potential biological removal level as a result of commercial fishing, the take reduction plan must include measures to reduce mortality and serious injury below that level within six months.[415] For those stocks that exceed the potential biological removal level as a result of other human activity in addition to commercial fishing, the take reduction plan must include measures to reduce mortality and serious injury from commercial fishing to the maximum extent possible within six months.[416]

The potential biological removal level sets a cap for incidental takes and serious injury to marine mammals. This adds consideration of cumulative impacts to the MMPA permitting structure by setting a management objective that is applicable to the entire fishing sector. The MMPA does require the effects of other sectors to be considered in determining the 6-month objectives of a take reduction plan: if the fishing sector would not have exceeded the potential biological removal level on its own, the plan must only reduce mortality and serious injury to the maximum extent possible rather than below the level. This provision strives to reduce the effects of the fishing sector on marine mammal populations, but it avoids solutions that address cumulative impacts of multiple sectors. While there is no explicit margin of safety required below the potential biological removal level, the fact that the long-term objective of the MMPA is to reduce incidental mortality and serious injury to zero serves that purpose. The MMPA provides a permitting scheme that reduces the cumulative impacts of the activities of a single sector below a target level, but does not extend those regulations to cover the effects from all sectors.

413 § 1387(f)(9).
414 § 1362(20).
415 § 1387(f)(5)(A).
416 § 1387(f)(5)(B).

2.3. Conduct more thorough cumulative impact analyses in permitting process.

Rationale: Several current federal and state laws require permit applicants to consider cumulative impacts when conducting environmental reviews or applying for permits. Exactly what is required in this analysis depends on the specific law, and is not fully clarified. At its core, a cumulative impact analysis reveals the expected consequences of the proposed activity when its direct and indirect effects are added to those of past, present, and future activities. As usually practiced, simple cumulative impact analysis may identify overlooked additive and synergistic effects arising from diverse activities across sectors. But a more comprehensive analysis could provide the basis for EBM, identifying connections between terrestrial, freshwater, and marine environments and how activities in each interact.

The following section examines the more frequently litigated cumulative impact provisions of federal and state law, as well as examples of comprehensive analyses, in order to identify the expectations for and opportunities presented by cumulative impact analyses.

Example: Lessons Learned from Environmental Impact Assessment

Environmental impact assessment (EIA) occurs according to the federal National Environmental Policy Act (NEPA) and "state NEPAs" (state environmental impact assessment laws). This section provides a brief summary of EIA approaches from practitioners and the courts that could be expanded in other settings. Potential approaches to more effective cumulative impact analysis under NEPA and state NEPAs include:

- Use quantified or detailed information when conducting cumulative impact analysis. "General statements about 'possible' effects and 'some risk' do not constitute a 'hard look' absent a justification regarding why more definitive information could not be provided."[417]
- Consider the combined effects of individual projects throughout the region.[418]
- Include the following elements in an impact statement or assessment: geographic area affected; the impacts expected in that area from the proposed project; other past, present, and reasonably foreseeable future projects that have affected or are expected to affect that area; the effects or expected effects of these other actions; and the total

417 Neighbors of Cuddy Mountain v. U.S. Forest Serv., 137 F.3d 1372, 1380 (9th Cir. 1998).

418 *See e.g.,* Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt., 387 F.3d 989, 993 (9th Cir.2004) (holding that "Each of the EAs notes that the individual project may have short term adverse impacts on water quality [which would affect at-risk salmonids], but nowhere are the combined water quality effects of the four proposed sales contemplated." Likewise, "Each of the EAs recognizes that the proposed sales will adversely affect the habitat of spotted owls ... amount[ing] to a total of 1,881 acres of critical habitat. But this total number is not presented in either ... EA. More importantly, there is no discussion in any of the EAs about the effect of this loss on the spotted owl throughout the watershed.").

impact expected if individual effects accumulate.[419]

- Examine past, present and future activities when considering cumulative impacts.[420]
- Previous degradation should not necessarily allow for greater impact. According to the California Court of Appeal, "the greater the existing environmental problems are, the lower the threshold should be for treating a project's contribution to cumulative impacts as significant."[421]
- Analyze the full spectrum of potential impacts. The draft EIR for the Venoco Ellwood Oil Development and Pipeline Project divides analysis as follows: geological resources; hazards and hazardous materials; air quality; hydrology, water resources, and water quality; biological resources; cultural, historical, and paleontological resources; land use planning and recreation; public services; transportation and circulation; noise; aesthetic resources; energy and mineral resources; agricultural resources; and environmental justice.[422]

Example: Lessons Learned from Clean Water Act Section 404 Mitigation

Section 404 of the Clean Water Act authorizes the Army Corps of Engineers to regulate discharges of dredged or fill material.[423] Section 404 guidelines require that the Corps determine in writing the potential short- and long-term effects, including cumulative effects, of a proposed discharge of dredged or fill material on the aquatic environment.[424]

One of the more thorough descriptions of this requirement is found in *Ohio Valley Environmental Coalition v. U.S. Army Corps of Engineers.* In that case, three environmental organizations sought a declaration that the Corps violated the CWA and NEPA when it issued four permits to fill West Virginia headwater streams with byproduct material from mountaintop-removal coal mining.[425] The court in this case delineated four requirements that can be applied more broadly to cumulative impact decision-making.

In essence these requirements lead to the following principles:

- Consider the appropriate region for analysis that corresponds to the ecosystem of concern.[426]

419 U.S. Dep't of the Navy, Hawaii Range Complex: Final Environmental Impact Statement/Overseas Environmental Impact Statement 5-2 (2008).

420 *City of Carmel-by-the-Sea v. U.S. Department of Transportation*, 123 F.3d 1142, 1160-1161 (9th Cir.1997).

421 Communities for a Better Env't v. Cal. Res. Agency, 103 Cal. App. 4th 98, 120 (Cal. Ct. App. 2002).

422 Cal. State Lands Comm'n, Draft Environmental Impact Report for the Venoco Ellwood Oil Development and Pipeline (Full Field Development) Project iv-x (2008).

423 33 U.S.C. § 1344 (2000).

424 40 C.F.R. § 230.11.

425 Ohio Valley Envtl. Coalition v. U.S. Army Corps of Eng'rs, 479 F. Supp.2d 607, 614 (S.D.W.Va. 2007).

426 *Id*. at 660. In this case, the court stated that by failing to consider the hollows surrounding the streams, the Corps inappropriately narrowed the analysis of cumulative impacts

- It is not enough to state the impact and then find insignificance. There should be a rational connection between the facts and the cumulative impacts decision.[427]
- Even if mitigation makes a specific impact insignificant in isolation, it may not render the cumulative impacts insignificant.[428]
- Preexisting disturbances do not mean that added destruction is not a significant impact.[429]

The *Ohio Valley* decision suggests that there are limits to the role of mitigation strategies in CWA cumulative impact analyses, that the analysis linking the facts to the conclusions is as important as the facts themselves, that a cumulative impact analysis for even a subsection of an ecosystem requires consideration of the broader effects of an activity, and that evaluating cumulative impacts are as important in heavily degraded areas as pristine ones. While this case pertains to freshwater resources, as is true for most CWA Section 404 decisions, its lessons are equally applicable in marine waters. Furthermore, the push by the *Ohio Valley* court for the Corps to consider the downstream effects of headwater stream destruction suggests the practice of setting a spatial scope for CWA cumulative impact analysis that includes all potentially affected waters, extending where reasonable to estuaries and the sea.

Example: Lessons Learned from Endangered Species Act Cumulative Impact Analysis

The first step in the Endangered Species Act Section 7 consultation process is for the federal agency contemplating action to decide whether that action "may affect listed species or critical habitat."[430] If the answer is "yes," the agency must consult with the either the Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS), depending on the species.[431] This consultation will result in a Service-issued biological opinion[432] that summarizes the proposed action, discusses the effects of that action on listed species, and determines whether that action is likely to jeopardize a listed species or adversely modify its critical habitat.[433]

427 *Id*. at 659. The court found that the Corps failed to make a "rational connection" between the facts and the cumulative impact determinations. For each permit, the Corps detailed the total amount and percentage of stream loss, but then concluded without discussion that those losses did not amount to a significant impact.

428 *Id*. at 659. The court presumed that, since the Corps gave no rational explanation for its cumulative impact determinations, it rested those determinations entirely on proposed mitigation plans. According to the court, multiple permitted activities with individually "mitigated-to-insignificant" effects do not inherently result in a cumulatively insignificant impact.

429 *Id*. at 659-660. Fourth, the court held that the preexisting disturbance to the watershed caused by mining did not relieve the Corps of at least examining and explaining how the added destruction to headwater streams will not cause a significant impact on the aquatic environment.

430 50 C.F.R. § 402.14(a).

431 *Id*.

432 *Id*. at § 402.14(e)(3).

433 *Id*. at § 402.14(h).

In making this jeopardy decision in the biological opinion, the FWS or NMFS must consider the cumulative effects, in addition to the direct and indirect effects, of the action on listed species and critical habitat.[434] The ESA defines "cumulative effects" as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation."

In *National Wildlife Federation v. Norton*, three conservation organizations challenged the Corps' issuance of a CWA 404 permit.[435] The Corps' Biological Opinion includes several apparent justifications for its no jeopardy decision, including the corridor, population size, recovery rates, and the percentage of habitat that would be disturbed by the project.[436] While each of these included substantial data, the court found that the Biological Opinion completely failed to discuss private projects likely to occur in panther habitat.[437] The court stated that "[i]f the requirement to evaluate cumulative effects is to mean anything, the FWS must not only explain what its 'disturbance intensity' numbers mean for panther habitat now, but what part the Florida Rock project will play in the reasonably expectable degradation over time of the habitat upon which 'one of the most endangered large mammals in the world' depends."[438]

In *Blue Water Fishermen's Association v. NMFS*, a fishermen's association sought access to pelagic longline fisheries after their closure by regulators due to the effects of that activity on endangered sea turtles.[439] The fishermen's association claimed that the Biological Opinion was "arbitrary and capricious" since the longline fishing industry is only one small contributor to the jeopardy of the sea turtle populations.[440] The court held that, since the ESA requires the NMFS to consider "the action, taken together with cumulative effects" in its jeopardy decision, "[t]he NMFS need only have found that the pelagic longlining threat together with other cumulative effects add up to jeopardy."[441] Hence, longlining need not be the predominant or even a significant cause of the jeopardy for it to be found a jeopardizing activity. The court held that the Biological Opinion was consistent with the ESA given its significant attention to other anthropogenic effects on the sea turtles and the explicit role it played in the NMFS jeopardy decision.[442]

434 *Id.* at § 402.14(g)(4).
435 Nat'l Wildlife Fed'n v. Norton, 332 F.Supp.2d 170, 172 (D.C. Cir. 2004).
436 *Id.* at 176.
437 *Id.* at 178.
438 *Id.* at 179.
439 226 F.Supp.2d 330 (D. Mass. 2002).
440 *Id.* at 341.
441 *Id.* at 342.
442 *Id.*

2.4. Establish mechanisms to prevent or mitigate impacts or enhance ecosystems.

Rationale: Connected to cumulative impact analysis is responding to that information by preventing or mitigating impacts or otherwise enhancing the ecosystem. Such protection, mitigation, and enhancement activities are often associated with development and required under several federal laws including, for example, the Federal Power Act (regulating dams), the Endangered Species Act, the Marine Mammal Protection Act, and the Clean Water Act. To connect prevention, mitigation, and enhancement to ecosystem-based management, these single-activity actions must somehow be connected to a broader planning and management system. This section briefly explores ways that protection, mitigation and enhancement requirements are and could be connected to a broader planning and management system.

Example: Linking Mitigation and Planning—Connecting Mitigation to State Wildlife Action Plans

Several federal and state laws require compensatory mitigation to address environmental harm and degradation associated with permitted and unpermitted human activities. The amount of funds spent annually to address mitigation requirements under the CWA Section 404, ESA Section 10, federal natural resource damage programs, Federal Power Act, and the Northwest Power Act exceeds $3.5 billion, with a vast majority of those funds relating to the CWA Section 404 activities ($2.9 billion).[443] Often decisions to spend such funds are narrowly tailored to address case-by-case or permit-by-permit impacts without considering the role of mitigation in the broader ecosystem management.

A 2007 report by the Environmental Law Institute explores and makes recommendations on how to connect federal compensatory mitigation programs to State Wildlife Action Plans—plans developed by all 50 states to better manage state wildlife and habitat.[444] The notion here is that a number of options may be available to address mitigation, and by consulting a larger plan, compensatory mitigation funds may help achieve both targeted mitigation objectives as required under the law, as well as contribute to larger ecosystem objectives. Recommendations include, for example, considering the broader needs of state wildlife and habitat as identified in the State Wildlife Action Plans to inform the expenditure of species-specific mitigation activities under the ESA.

443 ELI, Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities [hereinafter Mitigation Opportunities] 2 (2007).
444 *Id.*

Example: Coordinating Mitigation and Restoration across a Watershed—Columbia River Basin Hydropower

The Bonneville Power Administration regulates hydropower in the Pacific Northwest in accordance with the Northwest Electric Power Planning and Conservation Act (Northwest Power Act).[445] In addition to energy development, the Act establishes requirements "to protect, mitigate and enhance fish and wildlife" in the Columbia River watershed.[446] Rather than simply address mitigation on a project-by-project basis, the law establishes the Pacific Northwest Electric Power and Conservation Council.[447]

The Council has two functions related to mitigation: (1) give due consideration to protection, mitigation, and enhancement measures when developing energy plans and (2) create a Fish and Wildlife Program. To achieve its protection, mitigation, and enhancement objectives, the Fish and Wildlife Program creates basin-wide and sub-basin plans that guide decisions about protection, mitigation, and enhancement projects. After internal review and an independent scientific review, the Program chooses projects that support the plans.[448] In this way, mitigation activities are not simply performed on a case-by-case basis but are developed in the context of the regional ecosystem needs.

2.5. Minimize cumulative impacts when developing and implementing incentive-based management approaches.

Rationale: Government agencies often use incentives to encourage voluntary actions that will minimize human impacts on the environment. Government-based incentives can target other government agencies—e.g., federal government incentives for states to implement a program—or can target the private sector—e.g. government incentives to undertake specific conservation practices related to agriculture. The private sector may also develop incentive-based approaches to achieve sustainability objectives, including, for example, the creation of ecolabel programs. In many instances, such incentive-based approaches are single-sector or single-issue in focus. To move toward EBM, incentive-based programs should be framed and developed within an EBM context and should consider where possible how to address cumulative impacts within and across sectors.

445 Pacific Northwest Electric Power Planning and Conservation Act, Pub. L. No. 96-501; codified as 16 U.S.C. § 839 et seq. (1980).
446 § 839.
447 For a summary of the Council's role in protection, mitigation, and enhancement, *see* ELI, Mitigation Opportunities, *supra* note 443 at 97-98.
448 *Id.* at 99.

Example: Federal Support for State Action—Coastal Zone Management Act

One of the best examples of a cross-sector incentive-based ocean and coastal program is the program established under the Coastal Zone Management Act (CZMA). Coastal states develop coastal zone programs in exchange for federal grants and the authority to require federal actions to be consistent with the enforceable policies of approved coastal zone programs. These two incentives provide the basis for state participation in this federally conceived program. While the CZMA does not create specific requirements to minimize unsustainable human impacts, the expressed policies and substantive requirements support the development of programs designed to do just that.

In the CZMA Congress declares that it is the national policy to "preserve, protect, develop, and where possible, restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations"[449]—a broad statement that indicates the need for a cross-sector approach to sustainable management of coastal resources. It calls upon the states to develop programs that address the broad range of coastal issues in a way that maintains natural resources, while achieving economic development.[450] Substantive program requirements, which could be used to address cumulative impacts, include a requirement to develop "[b]road guidelines on priorities of uses in particular areas, including specifically those uses of lowest priority" and a planning process for siting and developing energy facilities.[451]

Example: Federal Support for Private Action—Vessel Buyback Programs

One example of a sector-based approach to reduce the impact of the sector is the development of vessel buyback programs to reduce fishing fleet capacity and thereby reduce fishing pressure. In 2003, NMFS implemented a voluntary fishing vessel capacity reduction program for the Pacific groundfish fishery that permanently removed 92 fishing vessels at a cost of approximately $46 million.[452] One hundred and eight groundfish permit owners submitted bids to participate in the program. Vessels were selected for removal based on a competitive bidding process. The program requires all vessels to be sold, scrapped, or converted to nonfishing purposes, and the program notified the U.S. Maritime Administration to restrict the transfer of vessel ownership or registry. These safeguards prevent the transfer of the overcapacity problem to another fishery in the U.S. or elsewhere.

A U.S. General Accounting Office (GAO) study of three vessel buyback programs demonstrates the challenges that vessel buyback programs must address to ensure that the incentives achieve

449 Coastal Zone Management Act § 303(1); 16 U.S.C. § 1452(1) (2005).
450 § 303(2); § 1452(2).
451 § 306(d); § 1455(d).
452 Pacific Fishery Management Council, Fisheries Management: Groundfish Vessel Buyback Program, *at* http://www.pcouncil.org/groundfish/gfbuy.html.

the desired social, economic, and environmental results.[453] For example, NOAA spent $24.4 million to remove 79 vessels from the New England groundfish fishery but failed to prevent inactive vessels from engaging in the fishery. Since the buyback 62 additional vessels became active. The GAO also found that nine of the participants in the buyback program shifted to the lobster fishery and thereby increased capacity in a fishery that was classified as overfished.

Example: Market-Based Approaches to Ecosystem Resiliency—Willamette Partnership

One of the classic examples of using markets to reduce human impact on the environment is the creation of cap-and-trade markets to reduce nitrous oxide and sulfur dioxide—two atmospheric pollutants that cause acid rain among other things. Regulators set the total allowable pollutant emissions, and industries can then buy, sell, and trade emissions credits to prevent exceeding emission limits. This and many other market-based approaches are single impact in scope. The Willamette Partnership, on the other hand, is developing a broader approach and seeks to "include[] transactions related to the full range of services that the ecosystem provides, from storing carbon and cooling river waters to mitigating floods and providing habitat for fish and wildlife."[454] To create this market, the Partnership is developing an integrated ecosystem credit calculator. The first version is designed to allow calculation of credits and debits for water quality, wetlands, salmonid habitat, and prairie with plans to expand the calculator to include other credit types.[455] With the expanding development of ecosystem service valuation, such an approach could be developed to support marine EBM.

3. Restoring Ecosystems after Degradation

3.1. Respond and restore after illegal discharge or injury.

Rationale: Illegal discharge or injury to the environment can lead to ecosystem degradation and loss of ecosystem services. Several federal and state laws exist to address so-called natural resource damages in the marine and coastal environment.[456] In most instances, the party causing the injury is held liable for the response, clean-up, and restoration of natural resources to baseline conditions.

453 U.S. General Accounting Office, Report to House Committee on Resources: Commercial Fisheries: Entry of Fishermen Limits Benefits of Buyback Programs (2000), *available at* http://www.gao.gov/archive/2000/rc00120.pdf.

454 Willamette Partnership, *Who We Are*, *at* http://www.willamettepartnership.org/.

455 Bobby Cochran, *Defining an Integrated Ecosystem Credit Calculator*, 2 Partnership News Report 1-3 (Jan 26, 2009).

456 For a comprehensive review of natural resource damage laws, *see* Valerie Ann Lee, P. J. Bridgen & Envt Int'l Ltd., The Natural Resource Damage Assessment Deskbook: A Legal & Technical Analysis (2002).

Example: Liability under the Comprehensive Environmental Response, Compensation, and Liability Act and the Oil Pollution Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Oil Pollution Act (OPA) make responsible parties liable for the clean-up of hazardous substances (CERCLA) and oil (OPA) and for the cost to restore natural resources to their pre-injury conditions.[457] The laws are narrowly tailored to ensure that recovered funds are used for the restoration, rehabilitation, replacement, or acquisitions of natural resources that were damaged. However, as with mitigation measures, expenditures for natural resource damages could be evaluated within the context of an EBM program and plan to satisfy both specific restoration requirements related to the injury and broader objectives related to the comprehensive management of the entire ecosystem.[458]

Example: Liability in National Parks and National Marine Sanctuaries

In addition to CERCLA and OPA, national parks and national marine sanctuaries, parks and sanctuaries have added protection through the Park System Resource Protection Act and the National Marine Sanctuaries Act.[459] Both laws provide place-based protection and hold responsible parties liable for any means of injury to park and sanctuary resources.[460] This includes, for example, damage to Florida National Marine Sanctuary coral reefs and sea grass beds due to ship groundings, propellers, and anchors.[461] When developing marine spatial management programs, lawmakers and regulators could consider the creation of a more comprehensive liability scheme to help minimize injuries to the natural environment.

457 Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§ 9601 et seq. (2000); Oil Pollution Act, 33 U.S.C. §§ 2701 et seq. (1990).

458 For an examination of use of State Wildlife Action Plans to inform natural resource damage expenditures, *see* ELI, Mitigation Opportunities, *supra* note 443 at 63-84.

459 Park System Resource Protection Act, 16 U.S.C. § 19jj (2000); National Marine Sanctuaries Act, 33 U.S.C. §§ 1401 et seq. (2000).

460 Lee, Bridgen & Envt. Int'l Ltd., *supra* note 456 at § 3.3.

461 A comprehensive list of natural resource damage cases is on file with authors. For a summary of this information, *see* ELI, Mitigation Opportunities, *supra* note 443 at 63-84.

3.2. Respond and restore after permitted degradation.

Rationale: Despite an enormous number of federal, state, and local laws, regulations, and policies geared toward preventing ecosystem degradation, habitat loss, and species decline, many ocean and coastal ecosystems are degraded and fail to support a full suite of ecosystem services. As many of the Handbook examples demonstrate, regional ocean governance programs often arise from the recognition that existing management systems fail to prevent ecosystem degradation, and many regional efforts focus on restoration. Some sector-or issue-specific laws create restoration requirements. For example, overfished fisheries trigger rebuilding requirements under the Magnuson-Stevens Fishery Conservation and Management Act, and depletion of individual species and populations to the point of endangerment triggers the Endangered Species Acts. In addition to sector-based examples, this section highlights regional and cross-sector approaches to restoration of marine and coastal ecosystems used to address cumulative human impacts.

Example: Rebuilding Requirements—Magnuson-Stevens Fishery Conservation and Management Act

In addition to a robust scientific-based program geared at preventing human impact beyond sustainable levels, federal law requires fisheries managers to take specific actions to recover a stock that is overfished or depleted. Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), fisheries are managed according to ten National Standards.[462] National Standard 1 requires that management measures prevent overfishing, and National Standard 8 calls for consistency with conservation requirements including preventing overfishing and rebuilding overfished stocks when taking into account and applying socioeconomic data.

While MSA creates a management system designed to avoid overfishing and depletion of fish stocks, in many instances it has failed to maintain harvests below the maximum sustainable yield. The plan must "specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished . . . . and, in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery."[463] When stocks are overfished, the fisheries councils must develop fishery management plans that include conservation and management measures necessary and appropriate to rebuild overfished stocks.[464] Therefore, the MSA creates a management system that prevents unsustainable use, creates objective and measurable criteria to determine when unsustainable harvest has been reached, and creates requirements to recover stocks to sustainable levels.

462 MSA, § 301(a); 16 U.S.C. § 1851(a) (2007).
463 § 303(a)(10); § 1853(a)(10)
464 § 303(a)(1)(A); § 1853(a)(1)(A).

Example: Recovery Requirements—Endangered Species Act

The great majority of such endangered or threatened species can attribute their status to human activities that impact the species or their habitats. The Endangered Species Act (ESA) has two approaches to aid the recovery of a species so that it once again is not threatened with extinction.

First, the ESA prohibits the further take of the endangered species with some exceptions and thereby limits harmful activities.[465] Second, the Secretary of Commerce (for most marine species) or the Secretary of the Interior is required to develop and implement recovery plans that include site-specific management actions, objective and measurable criteria to determine when a species can be removed from the list of endangered and threatened species, and estimates of the timeline for achieving the plan's objectives.[466]

While a single-species (not an ecosystem) is the focus, the ESA is cross-sector in approach. Its take limitations and recovery actions apply across sectors. Also, it is often provides a place-based approach focusing on the threatened or endangered species itself and the habitat needed for its survival. Endangered and threatened species can form the basis of an EBM program. For example, endangered salmon and orcas are viewed by some as two of the drivers for the development of the Puget Sound Partnership. ESA activities, including development and implementation of recovery plans, could be better coordinated with EBM efforts to develop more comprehensive management plans and strategies that could benefit both the individual threatened or endangered species as well as the broader ecosystem.

Example: Regional Restoration Programs—Chesapeake Bay Program and Puget Sound Partnership

Both the Chesapeake Bay Program and Puget Sound Partnership were developed to address and recover degraded ecosystems. The problems of the Chesapeake Bay were identified in the 1970s, and the Bay Program was initiated in 1983 to minimize impacts and restore habitats. Habitat restoration, pollution reduction programs, and fisheries management are aimed at reducing additional human impacts and restoring ecosystem health.[467] Despite more than 28 years of effort, the Bay Program has yet to reach its restoration goals[468]—an indication of the enormous difficulty of restoring damaged ecosystems in the face of continued development and expanding human populations.

465 Endangered Species Act, § 9(a); 16 U.S.C. § 1538(a) (2000).

466 § 4(f); § 1533(f).

467 Chesapeake Bay Program, *Bay Restoration*, *at* http://www.chesapeakebay.net/bayrestoration.aspx?menuitem=13989.

468 Chesapeake Bay Program, *Restoration and Protection Efforts*, *at* http://www.chesapeakebay.net/status_restoration.aspx?menuitem=15047.

The Puget Sound Partnership, established by Washington state law in 2007, aims to restore Puget Sound by 2020. It has recently published its Action Agenda, which includes priorities for restoration and the protection of intact systems.[469] Agenda actions include implementing and maintaining priority restoration projects with near-term actions to implement salmon recovery plans, large-scale restoration at the mouth of major river systems, and specifically restoring hundreds of acres of Puget Sound estuarine environments.[470]

469 Partnership Action Agenda, *supra* note 26.
470 *Id.*

VI. TRADEOFFS

A. Tradeoffs In Brief

Making explicit tradeoffs among potentially competing and conflicting ocean and coastal uses is an essential component of EBM. Done correctly, creating a system that explicitly makes tradeoffs should lead to management that (1) addresses cross-sector ecosystem impacts, (2) is fair, and (3) enables the identification and implementation of win-win scenarios.[471]

Most existing management practices are single-sector or single-issue in focus—e.g., fisheries management, land use management, and water quality management. To ensure ecosystem health, these strategies may include curtailing activities within a sector. This could mean, for example, fisheries actions such as reducing the total allowable catch or limiting the pool of license holders, or water quality actions such as reducing discharge of pollutants by decreasing the number of discharging facilities or tightening the allowable discharges from all facilities. Some of these decisions may include consideration of cross-sector impacts and broader ecosystem considerations. For example, federal agencies must consult with NOAA regarding activities that may impact essential fish habitat.[472]

While sector-based management is necessary, it is not sufficient for addressing the cumulative effects of human activities on ecosystems.[473] Human impacts are not merely additive—they can interact synergistically to cause greater impacts than the sum of the individual impacts. Also, while many sector-based laws and regulations set in-sector limits to prevent overutilization or excess degradation of the ecosystem, there are few mechanisms that consider and create limits for all activities collectively. This means that the full suite of human activities may injure the ecosystem, while still meeting sector limits when evaluated in isolation.[474]

Implicit in the consideration of tradeoffs is the concept of some threshold measure of overall impact that the ecosystem can absorb while still retaining desired ecosystem services. Without

471 *See, e.g.,* Heather M Leslie, Andrew A Rosenberg & Josh Eagle, *Is a New Mandate Needed for Marine Ecosystem-Based Management?* Frontiers Ecol & Envt 43 (2008) (discussing the pros and cons of ecosystem-based management, including a discussion of the relative merits of a new system of tradeoffs); *c.f.* Heather L. Keough & Dale J. Blahna, *Achieving Integrative, Collaborative Ecosystem Management*, 20 Conservation Biology 1373, 1374 (2006) (arguing for a "tension approach" rather than a tradeoffs approach. The tension approach integrates and balances social, economic and ecological goals, while, the authors argue, "[t]rade-off approaches may exacerbate management problems because socioeconomic or ecological concerns are prioritized to the extent that they dominate at the expense, or the exclusion, of the other.")

472 MSA, § 305(b); 16 U.S.C. § 1855(b).

473 *See, e.g.,* Leslie, Rosenberg & Eagle, *supra* note 471; *see also* Halpern et al., *Cumulative Impacts*, *supra* note 297.

474 *See, id.*, for a more thorough analysis of cumulative impacts.

having a target or proxy measures for maximum ecosystem use, it will be difficult to establish a scientifically rigorous system of tradeoffs.

Major obstacles to making tradeoffs to achieve healthy and resilient marine ecosystems include:

- Lack of scientific data to evaluate ecosystem service values and determine the thresholds that will maintain healthy and resilient oceans;[475]
- Insufficient legal mechanisms to decide upon, mandate, and enforce tradeoffs between competing uses;[476] and
- Failure of laws that do create priority uses to appropriately consider the need to maintain overall ecosystem health and resiliency.[477]

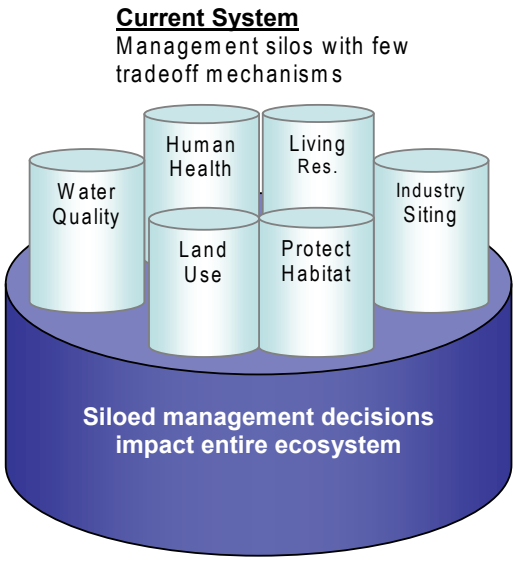
There are few existing regional ocean management programs that make proactive tradeoffs among potentially competing and/or conflicting uses. This section focuses on the identification and use of cross-sector tradeoff approaches that could be incorporated into EBM systems (Figure 11). In particular, this section examines approaches to valuing ecosystems and their services, making explicit tradeoffs, and resolving disputes once decisions have been made.

475 *See, e.g.,* Leslie, Rosenberg & Eagle, *supra* note 471 at 48; *see also* National Research Council, Valuing Ecosystem Services: Toward Better Environmental Decision-Making 8 (2004) [hereinafter NRC, Valuing Ecosystem Services]

476 *Id.*

477 For example, the International Joint Commission, tasked with managing water quality and quantity between U.S. and Canada, is mandated to prioritize use of shared water bodies. The priority uses do not include conservation.

Figure 11. Approaches to Making Tradeoffs



TRADEOFF APPROACHES

1. **Value societal, economic, and ecosystem benefits and harms.**
   - Develop system to quantitatively value ecosystem services;
   - Use experts or public process to determine values.
2. **Make explicit tradeoffs.**
   - Establish a governance process to make decisions based on consensus
   - Mandate prioritizing uses based on EBM principles and including conservation and preservation among the priorities.
   - Undertake marine spatial planning and management
   - Use market-based approaches to make tradeoffs
3. **Resolve disputes.**
   - Create a system of conflict resolution among sectors.

Figure 13 illustrates the siloed or sector-based nature of ocean and coastal management using six management categories as examples. While the management occurs in silos, the effects of management decisions—human use of ecosystems—affects the entire ecosystem. Developing a system of explicit tradeoffs allows proactive decision-making across management silos.

Valuing ecosystem services is an essential step in making tradeoff decisions that strive to balance human use with functioning ecosystems. As noted by the National Research Council, valuing ecosystem services requires integrating ecology and economics, and "[t]he fundamental challenge of valuing ecosystem services lies in providing an explicit description and adequate assessment of the links between the structures and functions of natural systems, the benefits … derived by humanity, and their subsequent values."[478] However, McCauley (2006) argues for caution with adopting the ecosystem-service rationale for conservation, because, for example, not all ecosystem function is beneficial to humans and the utility of the service may change as industries and technologies change.[479]

To achieve EBM, ecosystem service valuation should be linked to decision-making that retains essential ecosystem services based on the value of those services. This can be achieved, in part, by using the valuation result to make explicit tradeoffs among potential ocean and coastal uses that may compromise or enhance ecosystem services, with the goal of allowing sustainable human use.[480] In addition to creating a system of tradeoffs to maintain ecosystem

478 NRC, Valuing Ecosystem Services, *supra* note 475.
479 Douglas J. McCauley, *Selling Out on Nature*, 443 Nature 27 (2006).
480 *Id.* at 6 (recommending the use of economic valuation as a means of evaluating tradeoffs among policy choices).

services, tradeoffs should be created in a way that establishes a fair system of human use among competing or conflicting sectors. This can happen in two ways—at the outset through planning, and after planning is completed through conflict resolution systems. This chapter, therefore, considers both the creation of governance frameworks that allow tradeoffs at the planning stage, as well as governance frameworks that can be adopted to address dispute resolution.

B. Tradeoffs In Practice

1. Value Societal, Economic, and Ecosystem Benefits and Harms

1.1. Develop a system to quantitatively value ecosystem services.

Rationale: One of the challenges with developing and implementing a system of tradeoffs is the lack of mechanisms for appropriately valuing ecosystem services.[481] Several efforts are underway to comprehensively value ecosystem services, and examples are provided here. Once developed, these valuation approaches should inform EBM planning and implementation.[482] Another approach that could prove useful in the absence of a comprehensive valuation system is using values derived from existing management programs. These include for example, cost-benefit analyses that are conducted under NEPA or valuation of resources to determine liability in natural resource damages cases.

Example: Valuing Ecosystem Services—Natural Capital Project

Together, the Woods Institute for the Environment at Stanford University, The Nature Conservancy, and the World Wildlife Fund launched the Natural Capital Project in 2006. The goal of the project is to "provide maps of nature's services, assess their values in economic and other terms, and … incorporate those values into resource decisions."[483] The Project

481 For a summary of ecosystem valuation, *see* Ecosystem Valuation, *at* http://www.ecosystemvaluation.org/default.htm; *see also* L. Ledoux & R.K. Turner, *Valuing Ocean and Coastal Resources: A Review of Practical Examples and Issues for Further Action*, 45 Ocean & Coastal Mgmt 583 (2002); *see also,* NRC, Valuing Ecosystem Services, *supra* note 475.

482 For a description of one approach to linking ecosystem services to decision-making, *see* Gretchen C. Daily et al., *Ecosystem Services in Decision Making: Time to Deliver*, 7 Frontiers Ecol. & Envt. 21 (2009).

483 Natural Capital Project, *About the Natural Capital Project*, *at* http://www.naturalcapitalproject.org/about.html#Solution.

primarily includes ecosystem services pertaining to freshwater and terrestrial ecosystems. To accomplish its goals, the Project is developing new scientific methods, new financial tools, and recommending policies. It has already developed two tools. InVEST is a publically available method to model and map delivery, distribution, and economic value of ecosystem services:[484] its goal is to support decision-making based on ecosystem service valuation.[485] With this tool, users can evaluate the economic value of resources and human activities, as well as the biophysical costs and benefits. The Project is also creating a Natural Capital Database that includes strategies and outcomes from conservation programs worldwide.

Example: Valuation of Natural Resources—Natural Resource Damage Cases

Two federal statutes—the Oil Pollution Act and the Comprehensive Environmental Response, Compensation, and Liability Act—and many state laws hold responsible parties liable for restoring natural resources that were injured by hazardous waste or oil spills.[486] Federal and state statutes also require responsible parties to restore or pay the costs of restoring natural resources for any injury in specific protected areas including national parks and marine sanctuaries. As a result of these laws and the ensuing litigation, the field of natural resource damages has led to the development of various methods of natural resource valuation. Agencies engaged in natural resource damage assessments have regulations and guidance on methods of restoration costing, which could be applied when making tradeoff decisions.

For example, the Department of Interior uses several methodologies for estimating restoration costs including:

- **Comparison methodology** compares the costs of previous similar projects to determine costs of an anticipated project;
- **Unit methodology** estimates the cost of each restoration action "(e.g., the cost per adult bird produced by a breeding program);"
- **Probability methodologies** provide ranges of costs for restoration action, acknowledging the inherent uncertainty in valuation;
- **Factor methodology** uses the proportion or factor of an existing cost estimate and applies it at a different scale;
- **Time methodology** estimates cost based on the time needed to complete a task;
- **Cost- and time-estimating relationships** integrate the cost/time with the scale of the restoration requirements.[487]

484 Natural Capital Project, *Natural Capital Modeling and Mapping Tool*

485 Daily et al., *supra* note 482.

486 For additional information, *see* Lee, Bridgen, & Envt. Int'l Ltd., *supra* note 456.

487 Robert E. Unsworth & Timothy B. Petersen, A Manual for Conducting Natural Resource Damage Assessment: The Role of Economics 35 (1995) (prepared for Division of Economics, Fish and Wildlife Service, U.S. Department of Interior).

These methods will likely be most applicable when a program is weighing various potential restoration or mitigation responses rather than evaluating, for example, the costs and benefits of new activities. It is also limited in that it applies only to natural resources and does not consider other social and economic values.

Example: Valuing Costs and Benefits of Individual Action—NEPA Analysis

Under the National Environmental Policy Act (NEPA), federal agencies are required to develop environmental impacts statements for any federal action likely to significantly affect the environment. In considering potential actions and alternative actions, agencies may conduct cost-benefit analyses. According to NEPA regulations, cost-benefit analysis should include a discussion of "the relationship between that analysis and any analyses of unquantified environmental impacts, values, and amenities."[488] The regulation goes on to say that a cost-benefit analysis "need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."[489]

Examining relevant past environmental impact statements, as well as applying NEPA cost-benefit analyses to potential activities, could help regional bodies make tradeoff decisions in the absence of a more robust system for valuing ecosystem services and making tradeoffs.

1.2. Use experts or a public process to determine values.

Rationale: In the absence of a quantitative ecosystem service valuation program, EBM programs can use expert opinion or public opinion to determine the value of the resources and the activities that occur in the ecosystem. Many regional governance approaches use experts and the public to shape management decisions, which are often implicitly, if not explicitly, geared at balancing a range of potentially competing and conflicting uses.

Example: Expert Opinion to Value Resources—Massachusetts Ocean Management Initiative

The Massachusetts Ocean Management Initiative is combining scientific information, expert opinion, and public input to develop its ocean management plan. In accordance with the Massachusetts Oceans Act, the Secretary of Energy and Environmental Affairs is required to "identify appropriate locations and performance standards for activities, uses and facilities," as well as "identify and protect special, sensitive or unique estuarine and marine life and

488 40 C.F.R. § 1502.23.
489 *Id.*

habitats."[490] This proactive zoning approach necessarily requires tradeoff decisions to be made related to siting ocean activities and protecting special, sensitive or unique habitats and species.

To develop this plan and make these tradeoffs, the planning staff have conducted public listening sessions as well as interviews to understand the goals that the public would like to see included or not included in the plan.[491] In addition, expert working groups are using existing scientific information and expert opinion to support the identification of special, sensitive or unique species and habitats and areas of potential development. For example, the Habitat Work Group relied on its expert opinion to develop three "tracks" to support the determination of priority areas: (1) mapped areas/resources with special legal protection; (2) habitat critical to providing specific life stage support for important species or assemblages of species; and (3) habitats determined to be unique and/or sensitive based on abiotic parameters.[492] It also used expert opinion to determine "important" species or assemblages of species and used legal/regulatory data to determine legally protected areas and resources and identification of the locations of important species and assemblages.[493]

Example: Challenges of Multi-Stakeholder Collaborative Processes—CALFED Program

In response to drought, decreased water quality, and degraded ecosystems, four federal agencies—EPA, Bureau of Reclamation, National Marine Fisheries Service, and Fish and Wildlife Service—formed "Club Fed." In June 1994, Club Fed and California signed the San Francisco Bay Delta Agreement (the Accord) initiating a long-term planning process to improve the Delta and increase the reliability of its water supply. The Accord became the foundation of CALFED.[494]

In June 2000, CALFED developed a Framework for Action.[495] The Framework gives a broad overview of the anticipated actions of Stage 1, which covers the first 7 years of the 30-year program and which is intended to build the foundation for long-term actions. The Framework addresses specific program components such as: ecosystem restoration, watersheds, environmental water account and ESA commitments, water quality, levees, science, governance, and a regional approach to ecosystem and water management. However, CALFED, like many collaborative programs, has struggled to make the difficult decisions to limit some activities in order to maintain the health of the ecosystem. Several people, long-involved with CALFED, identify as challenges: consensus-building to the point that nothing is accomplished, a vision

490 Mass. Gen. Laws ch. 21A § 4C (2008).

491 Consensus Building Institute, Massachusetts Oceans Planning Public Listening Sessions: Draft Summary of Issues, *available* at http://www.mass.gov/Eoeea/docs/eea/oceans/120308_list_session_summ.pdf.

492 Executive Office of Energy and Environmental Affairs, DRAFT Ocean Planning: Habitat Working Group Report 5 (2008), *available at* http://www.mass.gov/Eoeea/docs/eea/oceans/112608_oceanhabitat_wkgp_draft.pdf.

493 *Id.* at 8-23.

494 The San Francisco Bay-Delta Agreement (Dec 15, 1994), *available at* http://www.calwater.ca.gov/content/Documents/library/SFBayDeltaAgreement.pdf.

495 *Available at* http://resources.ca.gov/fnlfrmwk.pdf.

of win-win situations for all, and a system that lacks the authority and accountability needed to make difficult decisions.[496]

2. Make Explicit Tradeoffs

2.1. Establish a governance process to make decisions based on consensus.

Rationale: Previous research demonstrates that consensus-based decision-making can be an important component of an effective collaborative ecosystem management system.497 Keough and Blahna (2006) argue that "[i]n addition to being early (before decisions are made), inclusive, and interactive, collaboration requires joint decision making through consensus-based approaches."498 Consensus does not require unanimity but typically reflects a majority or super-majority view. It should be noted, however, that consensus-based decision making can play to the least common denominator leading to less-than-ideal decisions, avoidance of difficult decisions, or lack of innovative approaches.499

Example: State Approach—North Carolina Coastal Habitat Protection Plan
The 1997 North Carolina Fisheries Reform Act requires the Department of Environment, Health, and Natural Resources to develop a Coastal Habitat Protection Plan as a joint effort among the departmental divisions of marine fisheries, water quality, and coastal area management.[500] The Act requires members of the Coastal Resources Commission, the Environmental Management Commission, and the Marine Fisheries Commission to review and revise the draft on a consensus.basis. If the Commissions cannot come to agreement, the Act creates a dispute resolution process—a six-member conference committee is selected to facilitate the resolution.[501] Once created, the Commissions are required to ensure that their actions are consistent with the Plan to the maximum extent practicable.[502]

496 *See* Colin Sullivan, *California: Has the Ambitious CALFED Water-Supply Plan Run Aground?*, Greenwire (Sept. 17, 2008), *at* http://www.eenews.net/Greenwire/2008/09/17/1.
497 *See* Keough & Blahna, *supra* note 471 at 1374-75; *see also* Cary Coglianese, *The Limits of Consensus*, 41 Environment 28 (1999) (arguing that consensus-building does not ensure better decisions, save time or reduce conflict).
498 *Id.* at 1374.
499 *See, e.g.*, Robin Gregory, Tim McDaniels & Daryl Fields, *Decision Aiding, Not Dispute Resolution: Creating Insights through Structured Environmental Decisions*, 20 J. Pol'y Anal. & Mgmt. 415 (2001).
500 General Assembly of North Carolina, S.L. 1997-400 (House Bill 1097), § 143B-279.8 (1997).
501 § 143B-279.8(b).
502 § 143B-279.8(c).

Example: Federal Approach—Regional Fishery Management Councils

Under the Magnuson-Stevens Fishery Conservation and Management Act, regional fishery management councils are responsible for developing and amending fishery management plans.[503] The councils are composed of voting and non-voting members. A majority of voting members must be present to establish a quorum, and each decision must be made by a majority of the voting members present.[504] While this type of approach can serve as a model for a consensus-based approach, it should be noted that several scholars have criticized the regional fishery management councils for failing to appropriately represent all stakeholders, especially the conservation community.[505] This is a separate issue, but one that may limit the ability to achieve decisions based upon EBM principles.

2.2. Mandate priority uses based on EBM principles and include conservation and preservation among the priorities.

Rationale: Establishing priorities at the outset may help direct decision-making and program development. Also, creating a system of priority uses may help decide cases of user conflict that may arise. Several laws establish priority of use or access to resources that could serve as models for an EBM program established by law or soft-law agreement.

Example: National Wildlife Refuge System

While the National Wildlife Refuge System is largely based on preservation and not multi-use management, its lessons could be applied in the marine EBM context. One law among many related to the Refuge System is the 1962 Recreation Act, which requires "that public recreation be permitted in a refuge 'only to the extent that is practicable and not inconsistent with . . . the primary objectives for which each particular area is established.'"[506] It also includes an element of the precautionary approach, prohibiting recreation unrelated to the primary purpose of the

legislation until the Secretary of the Interior determines that the use will not interfere with the primary purpose of the refuge, and that funds are available to properly manage the activity.[507]

503 MSA § 302(h); 16 U.S.C. § 1852(h).
504 § 302(e); § 1852(e).
505 *See e.g.*, Josh Eagle, Sarah Newkirk, Barton .H. Thompson, Taking Stock of the Regional Fishery Management Councils (2003); Thomas A. Okey, *Membership of the Eight Regional Fishery Management Councils in the United States: Are Special Interests Over-Represented?*, 27 Marine Pol'y 193 (2003).
506 Robert L. Fischman, *The National Wildlife Refuge System and the Hallmarks of Modern Organic Legislation*, 29 Ecology L. Q. 457, 477-478 (2002) (quoting the Recreation Act).
507 *Id.* at 478.

The Refuge System is also managed in accordance with the 1966 Refuge Administration Act, which prohibits disturbances, takes, entry, and use with only three exceptions: (1) by authorized persons; (2) activities allowed as expressed in the founding documents; and (3) activities permitted by regulation.[508] This is another precautionary approach to management, which prohibits most uses in the absence of express provisions stating otherwise. The Administration Act also supports the prior Recreation Act, requiring that all permitted uses be compatible with the major purposes of the establishing documents.[509]

Finally, the Refuge System was revised with the passage of the National Wildlife Refuge System Improvement Act of 1997, which creates a conservation mission and outlines uses according to priority.[510] According to the Act, "[t]he mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats."[511] This can be interpreted as the primary use, since all other uses are subordinate to it.[512] Secondary uses are wildlife-dependent uses including hunting, fishing, wildlife observation and photography, environmental education, and environmental interpretation.[513] The Act does not specify a hierarchy among these wildlife-dependent uses. Finally, other uses are allowed, providing they do not interfere with the conservation mission and the wildlife-dependent uses.[514]

Example: International Joint Commission

The International Joint Commission (IJC) provides one example of an agreement that sets priorities in a legally binding treaty. Article VIII of the Boundary Waters Agreement provides the IJC with the authority to resolve disputes. Article VIII also provides the following order of precedence of use when deciding conflicts and states that uses that conflict with this list are not permitted:

1. Uses for domestic and sanitary purposes;
2. Uses for navigation, including the service of canals for the purposes of navigation;
3. Uses for power and irrigation purposes.[515]

The treaty establishing the IJC does not list conservation and preservation as priority uses, so while this model is useful in understanding how priorities may be established in a legally binding document, it does not have priorities based on EBM principles. Another more general limitation

508 *Id.* at 485-486.
509 *Id.* at 487-488.
510 *Id.* at 514-538.
511 *Id.* at 517-518 (quoting the Act).
512 *Id.* at 528.
513 *Id.* at 526-527.
514 *Id.* at 530.
515 Boundary Waters Treaty, Art VIII (1909).

of this approach is that it may reduce flexibility in decision-making at a later stage. As new uses are conceived, there may not be appropriate mechanisms to allow development of such uses.

Example: National Marine Sanctuaries Program

The National Marine Sanctuaries Act (NMSA) provides an example of an approach that could be adopted in another setting, and also provides a specific mechanism for establishing EBM programs in federal and state waters. First, a conservation priority is created in the purpose and policies of the Act: "The purpose and policies of this chapter are--…(6) to facilitate to the extent compatible with the primary objective of resource protection, all public and private uses of the resources of these marine areas not prohibited pursuant to other authorities."[516]

Once sanctuaries are designated, the Secretary of Commerce is required to prepare "[a] resource assessment that documents—(i) present and potential uses of the area, including commercial and recreational fishing, research and education, minerals and energy development, subsistence uses, and other commercial, governmental, or recreational uses."[517] Also, the terms of the designation must include "the types of activities that will be subject to regulation by the Secretary to protect those characteristics" that give the sanctuary its value.[518]

The NMSA does not prioritize uses beyond establishing the primary objective of resource protection. However, there may be opportunities to set up priorities more explicitly when designating the types of activities subject to regulation and developing regulations based on those designations.

2.3. Undertake marine spatial planning and management.

Rationale: Marine spatial management—also called marine spatial planning, area-based management, and ocean zoning—is a management approach that delineates permissible uses in specific geographic areas of ocean waters. Done correctly, marine spatial management provides a proactive way to address tradeoffs among competing and conflicting uses.519 Marine spatial management as an EBM tool means that decisions about where to allow different activities would be based on maintaining ecosystem function as a primary objective.

516 National Marine Sanctuaries Act, § 301(b)(6); 16 U.S.C. §1431(b)(6).
517 § 394(a)(2)(B); § 1434(a)(2)(B).
518 § 394(a)(4); 16 U.S.C. § 1434(a)(4).
519 Halpern et al., *Cumulative Impacts*, *supra* note 297.

Example: Zoning State Waters—Massachusetts Integrated Ocean Management Plan

The Massachusetts Oceans Act of 2008 is the first state law that requires ocean zoning beyond the designation of marine protected areas or sector-specific zoning (e.g., fishery closure areas). Under the Act, the Secretary of Energy and Environmental Affairs is required to develop an integrated ocean management plan based upon EBM principles. The plan must "(i) set forth the commonwealth's goals, siting priorities and standards for ensuring effective stewardship of its ocean waters held in trust for the benefit of the public; and … (xv) shall identify appropriate locations and performance standards for activities, uses and facilities allowed…" under the Act.[520]

The plan also must identify and protect sensitive or unique estuarine and marine life and habitats.[521] The designations apply to all state agencies—"[u]pon the secretary's adoption of an ocean management plan, all certificates, licenses, permits and approvals for any proposed structures, uses or activities in areas subject to the ocean management plan shall be consistent, to the maximum extent practicable, with the plan."[522] The Oceans Act also creates a process for zoning state waters. The Secretary is the designated lead for development and implementation, working in consultation with an ocean advisory commission and ocean science advisory council.

Example: Federal Zoning of Conservation Areas—Florida Keys National Marine Sanctuary

In 1997, the Florida Keys National Marine Sanctuary developed a comprehensive zoning scheme in accordance with the fundamental conservation mandate of the National Marine Sanctuaries Act.[523] According to the Sanctuary management plan, "[t]he objectives for marine zoning are to: … [m]inimize conflicting uses … [p]rotect resources and separate conflicting uses by establishing a number of non-consumptive zones in areas that are experiencing conflict between consumptive and non-consumptive uses and in areas experiencing significant declines."[524] The Sanctuary is zoned according to five designations: sanctuary preservation areas (SPAs), ecological reserves, special-use areas, wildlife management areas (WMAs), and existing management areas.[525] Special-use areas include recovery areas, restoration areas, research-only areas, and facilitated use areas.[526] State and federal agencies share jurisdiction in the Sanctuary. NOAA is the primary agency responsible for SPAs, ecological reserves and special use areas. NOAA and USFWS share jurisdiction in the WMAs. Federal and state agencies administer the 21 existing management areas.[527]

520 Mass. Gen. Laws ch. 21A § 4C (2008).
521 § 4C
522 § 4C
523 NOAA, Nat'l Ocean Service, Nat'l Marine Sanctuary Program, Florida Keys National Marine Sanctuary Revised Management Plan [hereinafter NMSP, Florida Keys Plan] 142 (2007), *available at* http://floridakeys.noaa.gov/pdfs/2007_man_plan.pdf.
524 *Id.* at 144.
525 *Id.* at 142.
526 15 CFR § 922.164
527 NMSP, Florida Keys Plan, *supra* note 523 at 133.

Example: Zoning State Water and Beyond—Rhode Island Special Area Management Plan

The Coastal Zone Management Act defines a special area management plan (SAMP) as "a comprehensive plan providing for natural resource protection and reasonable coastal-dependent economic growth containing a detailed and comprehensive statement of policies; standards and criteria to guide public and private uses of lands and waters; and mechanisms for timely implementation in specific geographic areas within the coastal zone."[528] Rhode Island is using its SAMP authority to develop an Ocean SAMP, undertaking marine spatial planning for both state and federal waters. One of the goals of the Ocean SAMP is to streamline federal and state permitting processes and avoid the need for an EIS for any one project—the idea being that the research involved in the SAMP, and consequent zoning, should justify a "finding of no significant impact" for the site chosen because the site will be selected for its lack of impact.[529] The CRMC also intends to use the SAMP as a means of collaborating with federal agencies, a necessity given the extension of the spatial planning boundary into federal waters.[530]

2.4. Use market-based approaches to make tradeoffs.

Rationale: Another way to make tradeoffs is through the use of market-based approaches, especially the creation of markets or cap-and-trade systems that allow resources to be bought, sold, or traded. Most such markets to date focus on single sectors or single pollutants. For example, the NOx and SOx cap-and-trade system creates a cap on NOx and SOx emissions and allows individual companies to buy and sell emissions to meet the cap. Increasingly, fisheries are employing such a system with the development of individual transferable quotas (also known as catch shares, individual fishing quotas, limited access privilege programs, and dedicated access programs). In these systems, fishery managers set the total allowable catch, and fishers have the opportunity to buy, sell and/or trade percentages of that catch or quotas.

Advantages of market-based approaches include providing flexibility to the regulated community,[531] facilitating conservation, and reducing conflict.[532] General challenges include monitoring and enforcement, developing a system of liability, and linking the market to long-term conservation and management goals. For more complex ecosystem markets, scientific challenges exist to establishing the market, and program development is difficult when different legal and regulatory requirements apply to different aspects of the market.

528 16 U.S.C. § 1453(17)

529 R.I. Coastal Res. Mgmt. Council & Univ. of R.I., *supra* note 361 at 1 (2008).

530 *Id.*

531 *See e.g.,* James Boyd, Kathryn Caballero & R. David Simpson, *The Law and Economics of Habitat Conservation: Lessons from an Analysis of Easement Acquisitions*, Discussion Paper 99-32 (1999).

532 Rodney M. Fujita, Tira Foran & Ianthe Zevos, *Innovative Approaches for Fostering Conservation in Marine Fisheries*, 8 Ecological Applications S139, S144 (1998).

Example: Ecosystem Markets—Willamette Partnership and Bay Bank

In Oregon, the Willamette Partnership is under development with the goal of creating an ecosystem services market.[533] With funding from EPA, the Partnership began as a water quality trading program, adopting the following criteria for the program:

- It is trusted by regulated parties, private land managers, regulatory agencies and the public
- It meets specific TMDL objectives for reducing temperature in the Willamette River
- drives investments to restoration actions that provide the greatest environmental return to the Willamette watershed
- It provides financial incentives for land managers to restore priority areas on a coordinated schedule
- It is capable of facilitating transactions in a variety of ecosystem service credit types that address a full suite of ecological values.[534]

With additional support from the Natural Resources Conservation Service, the Partnership is developing tools to create markets for "water quality improvements, wetland restoration, habitat conservation and carbon sequestration" and ultimately creating an integrated ecosystem service marketplace.[535]

The Bay Bank program is an ecosystem service market under development in the Chesapeake Bay region. The goal of the program is to "provide one regional, multi-credit, ecosystem service platform and build upon existing national, state, and local ecosystem markets, including carbon sequestration, water quality protection, forest conservation, habitat conservation, and traditional conservation programs."[536] To achieve its goals, the Bay Bank is in the process of developing the LandServer—a web-based tool that will allow land owners to determine their eligibility to participate in the ecosystem services markets.[537] In addition, the Bay Bank is developing its Marketplace—an online platform to engage in ecosystem credit transactions.

533 Willamette Partnership, *at* http://www.willamettepartnership.org/.

534 Willamette Partnership, Counting on the Environment, *available at* http://www.willamettepartnership.org/ongoing-projects-and-activities/wp-accomplishments-for-counting.pdf.

535 *Id.*

536 Pinchot Institute for Conservation, *The Bay Bank: A Marketplace of Opportunity*, *at* http://www.pinchot.org/current_projects/baybank.

537 Bay Bank, *The Chesapeake's Ecosystem Service Marketplace*, *at* http://www.thebaybank.org/.

3. Resolve Disputes

3.1. Create a system for resolving disputes among sectors.

Rationale: While many public participation processes are designed to avoid future conflict, disputes do still occur over the course of implementation. Therefore, in addition to developing participatory governance systems that seek to address problems proactively through information-sharing, stakeholder input, and collaboration, EBM programs may wish to develop robust dispute resolution mechanisms.[538] Under U.S. law and policy, dispute resolution ranges from traditional administrative or civil court cases to more comprehensive and collaborative dispute resolution programs. Dispute resolution systems can include processes to address individual concerns as well as the concerns of specific institutions and agencies.

Example: Supporting Program—U.S. Institute for Environmental Conflict Resolution

The U.S. Institute for Environmental Conflict Resolution (Institute for ECR) is an independent federal agency tasked with helping resolve environmental disputes through mediation, training, and other services.[539] The Institute for ECR provides both free and fee-based services. However, a federal agency must be involved in the dispute in order to utilize the Institute and its services.

Example: A State Governance Approach—Puget Sound Partnership

In accordance with state statute, the Puget Sound Partnership Council is required to provide a forum for addressing and resolving problems and conflicts.[540] The statute states that "[t]he council may use conflict resolution mechanisms such as but not limited to, technical and financial assistance, facilitated discussions, and mediation."[541] If the parties in dispute, together with the Council, are unable to solve the problem, the statute requires the Council to provide an analysis and make recommendations to the governor, legislature, and other entities with jurisdictional authority to resolve the conflict.[542]

538 For a summary of legal frameworks related to collaborative governance, see Pub. Pol'y Res. Inst., Univ. Montana, *The Legal Framework for Cooperative Conservation,* Collaborative Governance Report 1 (2006), *available at* http://cooperativeconservation.gov/library/LegalFrameworkCC.pdf.

539 U.S. Institute for Environmental Conflict Resolution, *About Us*, *at* http://www.ecr.gov/HowWeWork/AboutUs.aspx#mission

540 ESSB 5372, § 17(4) (Wash. 2007).

541 § 17(4).

542 § 17(4).

VII. CONCLUSIONS: MAJOR GAPS AND BEST OPPORTUNITIES

This Handbook has been designed as a resource that describes potential options for EBM implementation, focusing particularly on legal, policy and institutional approaches to engaging in ecosystem planning, connecting science with management, developing accountable and adaptive governance systems, and crafting systems to address cumulative impacts and make tradeoffs. These Conclusions highlight some of the largest governance gaps in EBM concepts and implementation, and the best opportunities for achieving success in practice.

Ecosystem Planning

Developing an EBM plan involves consideration of complex issues and requires input from a broad set of stakeholders who have different goals and values. Thus, one of the chief challenges is to create a strategic, targeted, and achievable plan. A variety of adaptive management frameworks, including the NOAA Integrated Ecosystem Assessment (IEA) and The Nature Conservancy 5-S Framework for Conservation Project Management, can be adopted to help overcome this challenge.

Another key challenge is creating concrete goals and measurable indicators upon which to evaluate success. These goals and indicators are important for the adaptive management process and as a mechanism to create accountability in the management system. The Chesapeake Bay Program's "realistic annual targets" and "dashboards" provide a good example of measurable indicators and a reporting tool that informs the public, providing an accountability mechanism.

Ecosystem Science and Information

EBM requires proper incorporation of the best available science into decision-making processes. A major challenge to achieving this includes the lack of appropriate scientific data. Continued funding for ecosystem data collection to establish baseline conditions, combined with continued monitoring to inform the adaptive management process, are both essential to understand baseline conditions and inform adaptive management. Programs such as the Integrated Ocean Observing Systems that are tasked with long-term monitoring could support regional EBM initiatives, and federal initiatives such as NOAA's IEA could help establish appropriate baselines.

Inefficient transfer of data to and utilization by governing institutions is another key challenge. One increasingly popular way to inform and engage stakeholders and decision-makers is to develop digital maps that link ecological and social data. This approach also fits well with expanding efforts to engage in marine spatial planning and management. The NOAA Coastal Services Center Marine Cadastre is one new tool that provides jurisdictional information, and

both New York and Massachusetts are engaged in programs to develop high resolution digital maps that integrate social and ecological information.

Additional approaches to overcoming data transfer and utilization hurdles include the development of regional information systems and the standardization of data collection and requirements across jurisdictions and sectors, as is seen with the Southern California Coastal Water Research Project.

Accountability and Adaptive Management

Accountability and adaptive management are linked issues—a good adaptive management system should create the information and procedures for evaluating and reporting that information in a way that creates accountability. Major challenges to effective adaptive management include creating concrete goals and measurable benchmarks as described in the Ecosystem Planning section, and conducting effective and consistent monitoring as described in the Ecosystem Science and Information Section.

In addition to these hurdles, a major accountability challenge is the lack of EBM mandates that require agency participation and implementation action. A few coastal states have passed laws to support EBM, including Washington, New York, and Massachusetts. Massachusetts provides a regulatory model with specific mandates that require state and federal agencies to take actions that are consistent with an ocean plan. While more advisory and restoration-based, the Puget Sound Partnership provides an example of an enabling statute that creates accountability through public process, incentives, and legislative oversight.

Cumulative Impacts and Tradeoffs

At the heart of ecosystem-based management is the need to minimize the cumulative human impacts on ecosystems in order to maintain the services upon which humans depend. Lack of scientific information and legal and institutional structures that react rather than act proactively hinder efforts to adequately consider and make decisions about potential human impacts. Part of this challenge includes the lack of existing structures for making well-informed tradeoffs among competing and/or conflicting uses that affect marine ecosystems.

One of the most promising and most often recommended approaches to overcoming these hurdles is ecosystem-based marine spatial management, which leads to the designation of specific areas for different uses considering the sensitivity of species and habitats, as well as the social and economic needs of the stakeholders. Both Massachusetts and Rhode Island are engaged in processes to develop marine spatial management programs. Massachusetts' program is the result of a new state statute mandating the development of an integrated ocean management plan. Rhode Island is conducting marine spatial management through its coastal

program, taking advantage of the Coastal Zone Management Act's provisions related to Special Area Management Plans.

Final Thoughts

The concepts underlying ecosystem-based management, including how best to design and implement EBM programs, are rapidly evolving. This Handbook highlights many programs that have been identified by EBM experts as good examples of existing EBM approaches or non-EBM approaches that could be adopted by EBM programs. It is the authors' hope that this Handbook will provide practitioners with concrete options for developing and implementing EBM programs and will inform those advancing the field of EBM governance.

APPENDIX A: Summary of Options and Examples

Appendix A provides a list of the options and examples discussed in this Handbook.

ECOSYSTEM-BASED VISION AND PLANNING

(1) OVERALL PLANNING APPROACHES.

OPTION: **Consider drivers for program development.**	
Degraded Ecosystems	Chesapeake Bay Program
	Puget Sound Partnership
Legislative Opportunity or Mandate	California Ocean Protection Council
OPTION: **Include appropriate institutions and stakeholders.**	
Planning with Experts and Stakeholders	Puget Sound Partnership
	Massachusetts Oceans Act
OPTION: **Use a strategic and adaptive process.**	
Analytical Frameworks	The Nature Conservancy Conservation Approach and 5-S Approach
	NOAA Integrated Ecosystem Assessment
Deliberations and Consensus	Chesapeake Bay Fishery Ecosystem Plan
	North Carolina Coastal Habitat Conservation Plan

(2) DEVELOP A REGIONAL VISION.

OPTION: Develop a vision that considers ecosystem, social, and economic needs.	
Table of regional visions	Gulf of Maine Council on the Marine Environment
	California Ocean Protection Council
	Gulf of Mexico Alliance
	West Coast Governors Agreement on Ocean Health
	Puget Sound Partnership
	Aleutian Islands Fishery Ecosystem Plan
	Chesapeake Bay Fishery Ecosystem Plan

OPTION: **Include specific target date to achieve overall vision.**	
Agreement-Based Target Dates	Chesapeake Bay Program
	Gulf of Maine Council on the Marine Environment
Mandated Target Date	Puget Sound Partnership

(3) CONDUCT THREATS ANALYSIS.

OPTION: **Describe specific threats and impacts that the regional plan and program will address.**	
Frameworks and Strategies	The Nature Conservancy 5-S Framework for Conservation Project Management
	NOAA Integrated Ecosystem Assessment
Regional Program Approaches	California Ocean Protection Council
	Gulf of Maine Council on the Marine Environment
	Gulf of Mexico Alliance

(4) IDENTIFY CONCRETE GOALS AND MEASURABLE INDICATORS.

OPTION: Use ecosystem assessments and threats analysis to inform development of concrete goals and measurable indicators.	
Sector-Specific Approach	Aleutian Islands Fishery Ecosystem Plan
Cross-Sector Regional Approach	Puget Sound Action Agenda
OPTION: **While working within a comprehensive EBM approach, keep concrete goals focused on key priorities.**	
Broad Goals to Annual Targets	Chesapeake Bay Program
Attainable Goal-Setting	Gulf of Mexico Alliance
OPTION: Include specific indicators to measure success.	
Fisheries Indicators	Chesapeake Bay
Water Quality Indicators	Everglades
Land Use Indicators	Gulf of Maine Council on the Marine Environment
Management Indicators	MPA Guidebook

(5) DEVELOP AN IMPLEMENTATION PLAN.

OPTION: Designate a lead agency.	
Activities Matrix	Gulf of Mexico Alliance
List of Actions and Institutions	California Ocean Protection Council
OPTION: Identify the legal authority to act.	
Legal Mandate	California Ocean Protection Act
	Massachusetts Ocean Act
Memorandum of Understanding	Chesapeake Bay
OPTION: Estimate implementation cost, funding sources, and cost of inaction.	
Cost of Action	Chesapeake Bay Commission
	Gulf of Maine Council on the Marine Environment
	Gulf of Mexico Alliance
Cost of Inaction	*Stern Review on the Economics of Climate Change*
	The Sunken Billions

ECOSYSTEM SCIENCE AND INFORMATION

(1) INCORPORATE SCIENTIFIC DECISION-MAKING THROUGHOUT THE EBM PROGRAM.

OPTION: Require decision-making based on sound science.	
Ecosystem Decision-Making	California Ocean Protection Council
Sector-Based Decision-Making	Magnuson-Stevens Fishery Conservation and Management Act
	Marine Mammal Protection Act
OPTION: Use a science committee to serve as liaison to the scientific community and to advise the regional governance body.	
State-Law Approach	California Ocean Sciences Trust and Ocean Protection Council
	Puget Sound Partnership
	Massachusetts Ocean Management Initiative
Soft-Law and Federal Approach	Chesapeake Bay Program

(2) USE AVAILABLE DATA TO INFORM MANAGEMENT DECISIONS.

OPTION: Use long-term monitoring data.	
Data Sources	Integrated Ocean Observing System Regional Associations
Data Sets	National Assessments Database
	National Land Cover Dataset
OPTION: **Synthesize existing data to evaluate multiple parameters of the ecosystem.**	
Synthesizing Regional Data	Aleutian Islands Fishery Ecosystem Plan
	Southern California Coastal Water Research Project
Synthesizing National Data	National Coastal Condition Report
OPTION: Map ecological and social data to inform decision-making.	
State-Based Approach	New York Ocean and Great Lakes Ecosystem Conservation Council
National Approach	NOAA Coastal Services Center
OPTION: Synthesize existing data to evaluate cumulative human impacts.	
	National Center for Ecological Analysis and Synthesis Human Impacts Study
	Use Marine Geospatial Ecology Tools to Make Management Decisions

(3) COLLECT NEW DATA TO INFORM MANAGEMENT DECISIONS.

OPTION: Develop a research plan based on regional needs.	
Multi-State Approach	Sea Grant Regional Research Support
Single-State Approach	Puget Sound Partnership
Federal Approach	Joint Subcommittee on Ocean Science and Technology Ocean Research Priorities Plan and Implementation Strategy
OPTION: **Fund targeted research that informs management decisions.**	
Creating a Trust	California Ocean Science Trust
Regional Opportunities	IOOS Regional Associations
OPTION: Be timely with data sharing.	
Interim Reports	Chesapeake Bay Program
OPTION: Use existing legal authority to consider multiple ecosystem parameters.	
Sector-Based Approach to Considering Ecosystem	Magnuson-Stevens Fishery Conservation and Management Act
Ecosystem Approach to Water Quality Management	Maine's Tiered Aquatic Life Uses

OPTION: Use permitting authority to ensure that permittees support ecosystem-based monitoring and research.	
Fisheries Permits	Magnuson-Stevens Fishery Conservation and Management Act
Water Quality Permits	North Carolina In-Stream Water Quality Monitoring Requirements
Wave Energy Permits	Wave Energy Development

(4) SHARE INFORMATION ACROSS SECTORS AND JURISDICTIONS.

OPTION: Establish linkages among institutions.	
Regional Science Collaboration	North Slope Science Initiative
Online Networking	EBM Tools Network
OPTION: Standardize information across jurisdictions and sectors.	
	Federal Fisheries Management
	Southern California Coastal Water Research Project
	National Water Quality and Assessment Program
OPTION: Develop regional information systems.	
Regional Information	Chesapeake Information Management System
National Information Center	Digital Coast

ACCOUNTABILITY AND ADAPTIVE MANAGEMENT

(1) GOVERNANCE STRUCTURE

OPTION: Mandate EBM.	
Building a Plan and Policy on Existing Law	New York Ocean and Great Lakes Ecosystem Conservation Act
Developing a Program for Restoration	Puget Sound Partnership
Developing a New Regulatory Framework	Massachusetts Oceans Act
Ensuring Federal Consistency	Coastal Zone Management Act
Mandating State and Federal Cooperation	Atlantic Coastal Fisheries Cooperative Management Act

OPTION: **Adopt an adaptive management framework.**	
Adaptive Management Strategy	Chesapeake Bay Program Action Plan
	Puget Sound Partnership Action Agenda
OPTION: Vest decision-making authority in regional body.	
Commission Authority	Delaware River Basin Commission
Agency Oversight Authority	Massachusetts Ocean Management Initiative
Sector-Based Authority	California Marine Life Protection Act
OPTION: Create strong public participation mechanisms.	
Connecting via the Internet	"Thank You Oceans" Campaign
Participation throughout Process	Puget Sound Partnership California Marine Protected Area Network
Public Forums and Meetings	Massachusetts Ocean Management Initiative
	California Ocean Protection Council
Sector-Based Participation	Fishery Management Councils
Citizen Suit Provisions	Endangered Species Act

(2) PLANNING REQUIREMENTS

OPTION: Create concrete goals and objectives.	
Land Use Goals & Objectives	Chesapeake Bay Program
Management Goals & Objectives	Gulf of Mexico Alliance
Invasive Species Goals	Gulf of Maine Council
Legal Basis for Concrete Goals and Objectives Development	Puget Sound Partnership
Legal Basis for Indicator Development	Massachusetts Oceans Act
OPTION: **Create measurable indicators.**	
Examples from Chapter II	Chesapeake Bay
	Everglades
	Gulf of Maine Council on the Marine Environment
	MPA Guidebook

(3) IMPLEMENTATION APPROACHES

OPTION: Evaluate implementation success.	
	Chesapeake Bay Realistic Annual Targets and Dashboards
OPTION: Require reporting.	
Internal Reporting	Puget Sound Partnership
External Reporting to Governor and Legislature	Puget Sound Partnership
Independent Review	Puget Sound Partnership
External Report	Chesapeake Bay Health Report Card
OPTION: Create incentives to participate in program and implement plans and repercussions for implementation failures.	
Funding, Implementation Support, and Public Engagement	Puget Sound Partnership

CUMULATIVE IMPACTS

(1) PRESERVATION BY LIMITING OR PROHIBITING HUMAN USE

OPTION: Designate marine no-take or no-use reserves.	
State-Based Approach	Chesapeake Bay Realistic Annual Targets and Dashboards
	California Marine Protected Area Network
Sector Specific Protection	Alaska Habitat Conservation Zones
Federal Approach	Florida Keys National Marine Sanctuary
	Papahānaumokuākea Marine National Monument
OPTION: Use private mechanisms to protect ecosystems.	
Federal Acquisition Program	NOAA Coastal and Estuarine Land Conservation Program
State-Based Protection Program	California Coastal Conservancy
Private Mechanisms for Marine Protection	The Nature Conservancy's Marine Conservation Agreements

(2) ALLOWING SUSTAINABLE HUMAN USE

OPTION: Develop marine spatial management.	
Coastal Management	Alaska Coastal Management Program
Coastal Zone Management	Rhode Island Ocean Special Area Management Plan
Marine Spatial Management	Massachusetts Ocean Management Initiative
OPTION: Establish thresholds for human use impacts, allowing ample margin for scientific and management uncertainty.	
A Quantitative Approach to Address Uncertainty about Impact	Magnuson-Stevens Fishery Conservation and Management Act
Creating a Margin of Safety	Clean Water Act
Classifying Human Use Impacts	Marine Mammal Protection Act
OPTION: Conduct more thorough cumulative impact analysis in permitting process.	
	Lessons Learned from Environmental Impact Assessment
	Lessons Learned from Clean Water Act Section 404 Mitigation
	Lessons Learned from Endangered Species Act Cumulative Impact Analysis
OPTION: Establish mechanisms to prevent or mitigate impacts or enhance ecosystems.	
Linking Mitigation and Planning	Connecting Mitigation to State Wildlife Action Plans
Coordinating Mitigation and Restoration across a Watershed	Columbia River Basin Hydropower
OPTION: Minimize cumulative impacts when developing and implementing incentive-based management approaches.	
Federal Support for State Action	Coastal Zone Management Act
Federal Support for Private Action	Vessel Buyback Programs
Market-Based Approaches to Ecosystem Resiliency	Willamette Partnership

(3) RESTORING ECOSYSTEM AFTER DEGRADATION

OPTION: Respond and restore after illegal discharge or injury.	
Discharge Liability	Comprehensive Environmental Response, Compensation, and Liability Act
	Oil Pollution Act

Ecosystem Liability	National Parks
	National Marine Sanctuaries
OPTION: **Respond and restore after permitted degradation.**	
Rebuilding Requirements	Magnuson-Stevens Fishery Conservation and Management Act
Recovery Requirements	Endangered Species Act
Regional Restoration Programs	Chesapeake Bay Program and Puget Sound Partnership

TRADEOFFS

(1) VALUE SOCIETAL, ECONOMIC, AND ECOSYSTEM BENEFITS AND HARMS

OPTION: Develop a system to quantitatively value ecosystem services.	
Valuing Ecosystem Services	Natural Capital Project
Valuation of Natural Resources	Natural Resource Damage Cases
	National Marine Sanctuaries
Valuing Costs and Benefits of Individual Action	NEPA Analysis
OPTION: **Use experts or a public process to determine values.**	
Expert Opinion to Value Resources	Massachusetts Ocean Management Initiative
Challenges of Multi-Stakeholder Collaborative Processes	CALFED Program
Regional Restoration Programs	Chesapeake Bay Program and Puget Sound Partnership
OPTION: Establish a governance process to make decisions based on consensus.	
State Approach	North Carolina Coastal Habitat Protection Plan
Federal Approach	Regional Fishery Management Councils
OPTION: Mandate priority uses based on EBM principles and include conservation and preservation among the priorities.	
	National Wildlife Refuge System
	International Joint Commission
	National Marine Sanctuaries Program

(2) MAKE EXPLICIT TRADEOFFS

OPTION: Undertake marine spatial planning and management.	
Zoning State Waters	Massachusetts Integrated Ocean Management Plan
Federal Zoning of Conservation Areas	Florida Keys National Marine Sanctuary
Zoning State Water and Beyond	Rhode Island Special Area Management Plan
OPTION: **Use market-based approaches to make tradeoffs.**	
Ecosystem Markets	Willamette Partnership
	Bay Bank

(3) RESOLVE DISPUTES

OPTION: Create a system for resolving disputes among sectors.	
Supporting Program	U.S. Institute for Environmental Conflict Resolution
State Governance Approach	Puget Sound Partnership

APPENDIX B: Glossary of Institutions

Appendix B provides a summary of laws and institutions cited in examples used in the Handbook, as well as a summary of particularly relevant guidance institutions. Some are specific institutions implementing regional governance plans. Others are sector-specific institutions that are engaged in activities or have programs that could be adopted for EBM. Still others are institutions that can provide supporting information, advice, and possibly technical support to EBM programs.

LAWS AND INSTITUTIONS

Alaska Coastal Management Program (http://dnr.alaska.gov/coastal/acmp/)

The Alaska Coastal Management Program is the state agency responsible for management of Alaska's coastal zone in accordance with state law and the federal Coastal Zone Management Act.

Handbook Example:

- Cumulative Impacts
  - An example of one way states can use their authority and authority derived from the Coastal Zone Management Act to engage in ocean and coastal spatial management, which should help minimize cumulative impacts.

Atlantic States Marine Fisheries Commission (http://www.asmfc.org/)

Established in 1942 by 15 Atlantic States using a state compact, the Atlantic States Marine Fisheries Commission manages fisheries resources in state waters.

Handbook Example:

- Accountability and Adaptive Management
  - An example of a state compact approved by an act of Congress (thus, a binding hard law agreement) mandating cooperation among states and the federal government.

Bay Bank (http://www.thebaybank.org/)

The Bay Bank is a Chesapeake Bay program under development and aimed at creating an ecosystem services market.

Handbook Example:

- Tradeoffs
  - A market-based mechanism to make tradeoffs among uses based on ecosystem services.

CALFED Program (http://calwater.ca.gov/index.aspx)

CALFED is a multi-agency federal and state partnership created to improve the conditions of the San Francisco Bay Delta watershed, which is used as an example of the challenge of creating a multi-stakeholder collaborative process that achieves stated objectives.

California Coastal Conservancy (http://www.scc.ca.gov/)

The California Coastal Conservancy protects and enhances coastal resources through property acquisition and other mechanisms.

Handbook Example:

- Cumulative Impacts
  - An example of a state-funded mechanism to protect ecosystems by acquisitions and easements.

California Ocean Protection Council (http://www.opc.ca.gov/)

The California Ocean Protection Council is a recently established advisory body focused on ocean and coastal management, including implementing ecosystem-based management. The Council and the underlying law establishing it, the California Ocean Protection Act, provide several examples of ways to implement EBM.

Handbook Examples:

- Ecosystem Planning
  - A legal mandate as a driver for EBM.
  - A vision statement to help frame its strategic plan.
  - A legal mandate delineating the authority to take EBM actions.
- Ecosystem Science and Information
  - Mechanisms for incorporating science in decision-making.
  - Mechanisms for funding ecosystem science.

California Ocean Sciences Trust (http://www.calost.org/)

Established in 2000 to foster collaboration and ensure best available science is incorporated into ocean management and policy decisions, the Trust now provides advice to the California Ocean Protection Council.

Handbook Example:

- Ecosystem Science and Information
  - A program that serves as a liaison to the scientific community and an advisor to the Ocean Protection Council.

Chesapeake Bay Commission (http://www.chesbay.state.va.us/)

The Chesapeake Bay Commission is a 21-member Commission composed of 15 legislators from the three Chesapeake Bay states (Virginia, Maryland, and Pennsylvania), the three state governors, and three citizens. It helps achieve Bay restoration goals through executive and legislative action.

Handbook Example:

- Ecosystem Planning
  - A program that has evaluated the cost of plan implementation.

Chesapeake Bay Program (http://www.chesapeakebay.net/)

Since 1983, the Chesapeake Bay Program has taken an ecosystem approach to restoring the Bay. It was established by a soft-law agreement between the Chesapeake Bay states and the federal government. The Program has expanded and undergone several revisions throughout its history to help achieve restoration goals. The Program provides several examples of options for EBM implementation.

Handbook Examples:

- Ecosystem Planning
  - Degraded ecosystems as a driver for EBM.
  - Establishing specific target dates to achieve success as part of the regional plan.
  - Use of realistic annual targets as concrete measures to help achieve its broad restoration goals.
  - Development of specific indicators against which to measure success including fisheries indicators.
- Ecosystem Science and Information
  - The use of scientific committees to support Program decisions.
  - The creation of interim reports to help connect management with scientific advances.
  - The creation of an information management system to help share modeling tools and data for use by planners, technical personnel, and the public.
- Accountability and Adaptive Management
  - The development of an adaptive management framework.
- Cumulative Impacts

- A program established to restore past and ongoing damage from continued human impact.

Delaware River Basin Commission (http://www.state.nj.us/drbc/)

The Delaware River Basin Commission was established by state compact to manage the Delaware River Basin, creating a multi-state and federal regional management system.

Handbook Example:

- Accountability and Adaptive Management
  - Demonstrates a hard law approach to a multi-state and federal partnership, using state compact to establish a regulatory body overseeing the management of the multi-state ecosystem.

EBM Tools Network (http://www.ebmtools.org/)

The EBM Tools Network is an alliance of EBM practitioners working together to develop and support the use of EBM tools in EBM implementation in ocean and coastal environments.

Handbook Example:

- Ecosystem Science and Information
  - An online networking approach to disseminating information about available EBM tools and how to use them.

A longer description is found in the following section, *Additional Information about Institutions Providing Guidance*.

U.S. Environmental Protection Agency (http://www.epa.gov)

The U.S. Environmental Protection Agency is the lead federal agency tasked with managing the water quality of the United States, and it supports several of the regional efforts described in this Handbook.

Federal Energy Regulatory Commission (http://www.ferc.gov/)

Under the Federal Power Act, the Federal Energy Regulatory Commission licenses hydropower projects including those related to dams and hydrokinetic energy (wave, current and tidal).

Handbook Example:

- Ecosystem Science and Information
  - Describes a wave energy siting process that creates licensing conditions, requiring licensees to collect relevant ecological data that could be used to inform EBM.

Florida Keys National Marine Sanctuary Program (http://floridakeys.noaa.gov/)

The Florida Keys National Marine Sanctuary is one of 13 national sanctuaries that preserves and protects natural resources by the designation of no-use reserves and limited use areas—a step in the direction toward more comprehensive marine spatial management.

Handbook Examples:

- Cumulative Impacts
  - The Sanctuary's designation of no-take and limited use areas provides an example of a preservation approach to impact reduction.
- Tradeoffs
  - An example of how spatial planning can minimize conflicting resource use.

Gulf of Maine Council on the Marine Environment (http://www.gulfofmaine.org/)

Established in 1989 to maintain and enhance environmental quality in the Gulf of Maine, the Council provides several examples of ways to approach regional governance and EBM.

Handbook Examples:

- Ecosystem Planning
  - Stated long-term goals as a vision for the 5-year implementation plan.
  - Target dates to achieve plan objectives and activities.
  - Plan that describes ecosystem threats and actions to overcome threats.
  - A work plan that includes cost of action and financing available.
  - Plan that includes concrete goals and objectives.

Gulf of Mexico Alliance (http://gulfofmexicoalliance.org/)

The Gulf of Mexico Alliance is a recently formed partnership among the five Gulf Coast states with support from relevant federal agencies that is focused on establishing regional collaboration to enhance the ecological and economic health of the Gulf. Several activities and approaches are useful when considering EBM implementation.

Handbook Examples:

- Ecosystem Planning:
  - A vision expressed in its plan that focuses on ecological and economic wellbeing.
  - A plan that addresses specific threats to ecosystem health.
  - A plan focused on practical and attainable goals.
- Accountability and Adaptive Management
  - A program that creates an implementation matrix that lists lead agencies as well as contributors and collaborators.
  - Concrete actions expressed in the Implementation Activities Matrix.

Integrated Ocean Observing System Regional Associations (http://ioos.noaa.gov/)

The Integrated Ocean Observing System is a federal program focused on providing continuous data on ocean and coastal environments. It implements its vision through Regional Associations designed to provide relevant monitoring data to resource managers and others.

Handbook Example:

- Ecosystem Science and Information
  - The Regional Associations provide a mechanism for linking targeted research to management decisions.

A longer description is found in the following section, *Additional Information about Institutions Providing Guidance*.

International Joint Commission (http://www.ijc.org/en/home/main_accueil.htm)

The International Joint Commission was established by the Boundary Waters Treaty of 1909 for the cooperative management of the freshwater resources shared by the U.S. and Canada.

Handbook Example:

- Tradeoffs
  - A system of prioritizing uses explicitly expressed in the treaty.

Joint Subcommittee on Ocean Science and Technology (http://ocean.ceq.gov/about/jsost.html)

The Joint Subcommittee on Ocean Science and Technology is tasked with identifying national ocean science and technology priorities, among other things.

Handbook Example:

- Ecosystem Science and Information
  - Federally developed research plan and implementation strategy focused on key interactions between society and the ocean.

Massachusetts Ocean Management Initiative (http://www.mass.gov/czm/oceanmanagement/index.htm)

The Massachusetts Initiative is the result of the passage of the Massachusetts Oceans Act in 2008, which requires Massachusetts to create and implement a comprehensive spatial plan for state waters. Several examples related to this program are described in this Handbook.

Handbook Examples:

- Ecosystem Planning
  - An example of a program engaged in planning with a broad range of experts and stakeholders through advisory bodies, meetings, and other participatory processes.

        - Demonstrates that state law establishes the requirements for EBM implementation.
        - Demonstrates a legal basis for indicator development requiring a plan that includes goals, siting priorities, and standards.
    - Ecosystem Science and Information
        - Makes use of a scientific committee to advise the program.
    - Accountability and Adaptive Management
        - Establishes a legal mandate for EBM implementation requiring action from the lead agency and requiring all agencies to be consistent with the plan.
        - Vests decision-making in one agency, creating a system of accountability.
        - Engages in extensive public participation including hosting public forums and meetings to share information and obtain feedback.
    - Cumulative Impacts
        - Mandates marine spatial management including consideration of habitats and species, which should result in minimization of cumulative impacts.
    - Tradeoffs
        - Relies on available science and expert opinion to establish priority areas for protection and development.

National Water Quality Assessment Program (http://water.usgs.gov/nawqa/)

The National Water Quality Assessment Program provides long-term data on U.S. water quality through direct stream analysis.

Handbook Example:

- Ecosystem Science and Information
    - Conducts comparable and uniform sampling and analytical methods while still tailoring analysis to meet specific ecosystem conditions.

National Wildlife Refuge System (http://www.fws.gov/refuges/)

The National Wildlife Refuge System is managed by the U.S. Fish and Wildlife Service and includes 550 refuges and other units in the system. Federal laws that create oversight and comprehensive management requirements for the refuges include the 1962 Recreation Act, the 1966 Refuge Act, and the 1997 National Wildlife Refuge System Improvement Act.

Handbook Example:

- Tradeoffs
    - Legal mechanism that establishes priority uses based on a fundamental goal of conservation and preservation.

Natural Capital Project (http://www.naturalcapitalproject.org)

The Natural Capital Project is developing tools to value ecosystem services in order to improve how land and waters are used.

Handbook Example:

- Tradeoffs
  - Develops quantitative tools for valuing ecosystem services.

New York Ocean and Great Lakes Ecosystem Conservation Council (http://www.nyoglecc.org/)

The New York Ocean and Great Lakes Ecosystem Conservation Council was established by state law in 2007 and tasked with "promot[ing] the understanding, protection, restoration and enhancement" of the ocean and Great Lakes ecosystems.

Handbook Examples:

- Ecosystem Science and Information
  - Maps social and ecological data for decision-makers and the public.
- Accountability and Adaptive Management
  - Legal mandate that establishes the Council and a policy focused on ecosystem health, productivity and resilience.

National Oceanic and Atmospheric Administration (NOAA) Priority Area Task Team (http://www.ncddc.noaa.gov/activities/noaa-regional-collaboration)

NOAA's Priority Area Task Team for Integrated Ecosystem Assessments is one of several collaborative efforts at NOAA focused on the Assessment approach as a way to synthesize and quantitatively analyze data in relation to ecosystem management objectives.

Handbook Example:

- Ecosystem Vision and Planning
  - Uses a five-step integrated ecosystem assessment to engage in a strategic and adaptive planning and implementation process.

NOAA Coastal Services Center (http://www.csc.noaa.gov/)

The Coastal Services Center works with federal and state agencies and others to provide information and training and helps build collaborations across institutions.

Handbook Examples:

- Ecosystem Science and Information
  - Maps social and ecosystem data to inform management including the Digital Coast Legislative Atlas.

- Serves as a repository for data, tools, and models and is a source of regional information.

A longer description is found in the following section, *Additional Information about Institutions Providing Guidance*.

NOAA Coastal and Estuarine Land Conservation Program (http://coastalmanagement.noaa.gov/land/)

The Coastal and Estuarine Land Conservation Program provides matching funds to states to acquire property or easements in coastal and estuarine lands for protection.

Handbook Example:

- Cumulative Impacts
  - Federal mechanism to acquire important coastal and estuarine property for the purpose of protection.

North Carolina Division of Water Quality, Discharge Monitoring Coalitions (http://h2o.ehnr.state.nc.us/esb/coalitions.html)

National Pollutant Discharge Elimination System (NPDES) permit holders collaborate with the Division of Water Quality to monitor water quality at various sites in the watersheds.

Handbook Example:

- Ecosystem Science and Information
  - Through a memorandum of understanding permit holders monitor water quality at 269 sites statewide in order to better assess ecosystem health.

North Pacific Fishery Management Council, Aleutian Islands Ecosystem Team (http://www.fakr.noaa.gov/npfmc/current_issues/ecosystem/Ecosystem.htm)

The Aleutian Islands Ecosystem Team was established by the North Pacific Fishery Management Council to help develop the Aleutian Islands Fishery Ecosystem Plan.

Handbook Examples:

- Ecosystem Vision and Planning
  - Plan expresses an EBM vision including the vision to provide measurable indicators to evaluate ecosystem health.
- Ecosystem Science and Information
  - Synthesizes available ecosystem data to inform management decisions.
  - Council used existing authority to develop ecosystem plan.

North Slope Science Initiative (http://www.northslope.org/)

The North Slope Science Initiative brings together local, state and federal institutions to "to facilitate and improve collection and dissemination of ecosystem information" in the North Slope region of Alaska.

Handbook Example:

- Ecosystem Science and Information
  - A regional science initiative aimed at developing ecosystem science through information sharing and collaboration.

Pacific Northwest Electric Power and Conservation Council (http://www.nwcouncil.org/)

The Pacific Northwest Electric Power and Conservation Council oversees the development and management of hydropower on the Columbia River.

Handbook Example:

- Cumulative Impacts
  - In accordance with the federal Northwest Power Act, the Council, through its Fish and Wildlife Program, takes protection, mitigation and enhancement measures throughout the watershed based on ecosystem needs.

Papahānaumokuākea Marine National Monument (http://hawaiireef.noaa.gov/)

Using the authority provided in the Antiquities Act, President Bush declared the Northwest Hawaiian Islands a national monument in 2006, now named the Papahānaumokuākea Marine National Monument.

Handbook Example:

- Cumulative Impacts
  - Creates a vast no-take reserve to preserve the Northwest Hawaiian Islands ecosystem.

Puget Sound Partnership (http://www.psp.wa.gov/)

The Puget Sound Partnership is mandated by state law to develop and implement an Action Plan to achieve a healthy Sound by 2020.

Handbook Examples:

- Ecosystem Vision and Planning
  - Driver for program development is the need to reverse the trend toward ecosystem degradation in the Sound.
  - Includes appropriate institutions and stakeholders in the planning process through topical forums and advisory bodies.
  - Expresses a vision of EBM that guides the action agenda.

        - State law sets a clear target date to achieve a healthy Sound by 2020.

        - Worked with NOAA's Integrated Ecosystem Assessment team to conduct assessment and threats analysis in order to set concrete goals.
    - Ecosystem Science and Information
        - Establishes a science advisory body to inform Partnership decisions and plan development.
        - Develops a research plan that is to be updated on a biennial basis.
    - Accountability and Adaptive Management
        - The Partnership is established by state law that mandates the development of an ecosystem plan and its implementation.
        - The Partnership's Action Agenda calls for an adaptive management approach.
        - Engages stakeholders and experts through forums, discussion papers and various stages including plan development and implementation.
        - The state law requires that the partnership develop measurable goals and objectives.
        - Extensive reporting mechanisms are employed including internal reporting from grantees to the Partnership and external reporting to the governor and legislature, as well as an independent review process.
        - Funding linked to plan implementation.
    - Cumulative Impacts
        - Takes a restoration focused approach to addressing past and ongoing human impacts to the Sound.
        - Provides a forum for addressing conflicts between the Partnership and its plan and other state institutions.

Rhode Island Coastal Resources Management Council (http://www.crmc.ri.gov/)

The Rhode Island Coastal Resources Management Council is leading the development of the Rhode Island Special Area Management Plan (SAMP), which is a marine spatial planning effort for state waters and implications for use in federal waters.

Handbook Examples:

- Cumulative Impacts
    - Engages in marine spatial planning making use of the Coastal Zone Management Act provisions allowing for the development of SAMPs.
- Tradeoffs
    - Engages in marine spatial planning, which allows tradeoff decisions to be made explicitly at the outset instead of in reaction to project by project proposals.

Sea Grant (http://www.seagrant.noaa.gov/)

Sea Grant is a federally funded program that includes a national office and university-based programs in each coastal state. Sea Grant programs support research, education, and outreach and work with communities through extension programs.

Handbook Examples:

- Ecosystem Science and Information
  - Developing regional research needs based on a needs assessment.
  - Working with the California Ocean Protection Council to help fund research that informs management decisions.

A longer description is found in the following section, *Additional Information about Institutions Providing Guidance*.

Southern California Coastal Water Research Project (http://www.sccwrp.org/)

The Southern California Coastal Water Research Project (SCCWRP) is a collaboration of federal, state, and local institutions focused on coastal water quality.

Handbook Examples:

- Ecosystem Science and Information
  - Synthesizes regional data including biological, physical and chemical data.
  - Conducts collaborative assessments using standardized methods and coordinated data.

The Nature Conservancy (http://www.nature.org/)

The Nature Conservancy is a non-profit organization focused on conservation and management of natural resources including ocean and coastal resources.

Handbook Examples:

- Ecosystem Planning and Information
  - Uses the 5-S Framework for Conservation Project Management as an adaptive management approach.
  - Its 5-S process includes a step to identify specific threats and impacts to ecosystems.
- Cumulative Impacts
  - Developed guidance for the development of marine conservation agreements, which include private property mechanisms for ocean and coastal preservation.

U.S. Institute for Environmental Conflict Resolution (http://www.ecr.gov/)

The Institute for Environmental Conflict Resolution is a federal agency that helps resolve environmental disputes that involve federal agencies.

Handbook Example:

- Tradeoffs
  - Provides support for conflict resolution among parties with competing and conflicting interests.

Willamette Partnership (http://www.willamettepartnership.org/)

The Willamette Partnership is a recent endeavor focused on creating a market for ecosystem services in the Willamette Basin in Oregon.

Handbook Examples:

- Cumulative Impacts
  - A market-based approach to minimizing human impacts based on ecosystem services.
- Tradeoffs
  - A market-based approach to making tradeoffs among competing uses that affect ecosystem services.

ADDITIONAL INFORMATION ABOUT INSTITUTIONS PROVIDING GUIDANCE

Communication Partnership for Science and the Sea (http://www.compassonline.org/)
The Communication Partnership for Science and the Sea (COMPASS) works to achieve ocean health through science-based solutions. COMPASS connects science with policy and management to achieve its objectives. It laid the groundwork for marine EBM with COMPASS-led publication of the *Scientific Consensus Statement on Marine Ecosystem Based Management*. COMPASS conducts regular science briefings to congressional staff, has made numerous EBM presentations, and is engaged in several projects to advance EBM science and understanding.

EBM Tools Network (http://www.ebmtools.org/)

The Ecosystem Based Management Tools Network supports the creation and use of EBM tools in marine, coastal, and watershed contexts. Membership includes groups that create EBM tools and those that use such tools in academic, governmental, and non-governmental settings. The network itself is coordinated by NatureServe. The group's primary creation is a public database of existing EBM tools, allowing those developing EBM programs to find and utilize

the most appropriate tools. The EBM Tools network particularly encourages tool development in areas considered underserved, such as Integrated Land-Sea planning and Social Science modeling. The Network generally promotes best practices for the use and creation of EBM tools with a particular focus on their interactivity and has recently begun a tools training program educating EBM practitioners on currently available tools and associated resources. The Network also serves as a resource for funding, technical assistance and data, streamlining EBM tool development and application through a full range of informational services.

Integrated Ocean Observing System (http://www.ocean.us/)

Congress created the National Oceanographic Partnership Program (NOPP) in 1997 with the enactment of Public Law 104-201. Led by the Secretary of the Navy, the program was created to promote national goals related to security, economy, quality of life, education and communication and to coordinate and strengthen oceanographic efforts through partnerships and annual reports to Congress.[543] NOPP is a partnership of 12 federal agencies including the Navy, NOAA, NSF, NASA, DoE, EPA, USCG, DoI/USGS, DARPA, DoI/MMS, OSTP and OMB. Through a joint memorandum of agreement (MOA), the agencies created the NOPP Interagency Ocean Observation Office (OCEAN.US) in 2000. Its goals are to establish a sustained integrated ocean observing system (IOOS) to meet seven objectives, which align with EBM objectives:

- Detect and forecast oceanic components of climatic variability
- Facilitate safe and efficient marine operations
- Ensure national security
- Manage resources for sustainable use
- Preserve and restore healthy marine ecosystems
- Mitigate natural hazards
- Ensure public health

The IOOS program is the U.S. contribution to the international Global Ocean Observing System (GOOS). The IOOS program is made up in part of regional associations (RAs) that focus on coastal observations. These include the following:

- Gulf of Maine Ocean Observing System (GoMOOS)
- Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA)
- Southeast Coastal Ocean Observing Regional Association (SECOORA)
- Gulf of Mexico Coastal Ocean Observing System (GCOOS)
- Great Lakes Observing System (GLOS)
- Southern California Coastal Ocean Observing System (SCCOOS)
- Central and Northern California Ocean Observing System (CeNCOOS)
- Northwest Association of Networked Ocean Observing Systems (NANOOS)

543 10 U.S.C. §7901.

- Pacific Islands Integrated Ocean Observing System (PacIOOS)
- Alaska Ocean Observing System (AOOS)

Joint Ocean Commission Initiative (http://www.jointoceancommission.org)
The Joint Ocean Commission Initiative JOCI) brings together the Commissioners from the U.S. Commission on Ocean Policy and the Pew Oceans Commission to work toward ocean policy reform. JOCI has developed several reports that provide insight into EBM governance. These include:

- *One Coast, One Future*—a report on high priority actions that local governments can take to improve ocean and coastal health.
- *An Agenda for Action*—a report proposing concrete actions to achieve regional ocean governance.

NOAA Coastal Services Center (http://www.csc.noaa.gov/)

An EBM program could consider working with the NOAA Coastal Services Center (CSC) to establish linkages among regional institutions and understand research and management frameworks. The CSC has provided a supporting role for regional ocean governance bodies. For example, in the Gulf of Mexico, the Director of NOAA CSC is also a Co-Chair of the Gulf of Mexico Alliance. The West Coast CSC has worked closely with the West Coast Governors Agreement efforts to support program development and planning.

EBM programs could also take advantage of CSC training programs to help develop or expand planning and implementation skill sets. CSC is especially focused on developing national tools for local users and providing the training needed to take advantage of these tools. When CSC does local trainings, typically a local organization will host and invite the appropriate participants, and the CSC trainer will conduct the training session onsite.

While CSC products and trainings are applicable at the local level, CSC does not have the capacity to create local products based on incorporation of local and national datasets. For example, CSC developed the Habitat Priority Planner that uses national data and can include local data. This tool can support local decision making. CSC provides the Habitat Planning tool and will provide training, but it does not have the capacity to conduct Habitat Priority Planning at the local level.

CSC is headquartered in Charleston, South Carolina and works regionally in New England, Chesapeake Bay, the Gulf of Mexico, the West Coast, and the Pacific Islands. It has an annual operating budget of approximately $25 million. The CSC is not established under any one law, although it derives much of its authority from Section 310 of the Coastal Zone Management Act calling for technical assistance to coastal states.

The mission of CSC is "to support the environmental, social, and economic well being of the coast by linking people, information, and technology." It serves state and local coastal resource managers (CZM programs, flood plain managers, Fish and Wildlife Service, and the National Sanctuaries Program, for example) as well as land trusts and conservancies, local chambers of commerce and others, and its operating principles are to take a client-driven, results-oriented approach that works with partners at the local level.[544] To determine product development needs, the CSC conducts a tri-annual survey of practitioners. It is supplementing this information with a literature review of publications that express the needs of coastal resource managers.[545]

CSC derives much of its data from NOAA's data management centers—the Climate Data Center, Geophysical Data Center, Ocean Data Center, and the Coastal Data Center. The data includes information collected from a wide variety of sources including satellites, buoys, and ships. Some are long-term datasets; other sources are single studies or projects. The Data Centers have until recently largely focused on data collection rather than distribution of data. However, increasingly NOAA is working to make the data sets available electronically.[546]

Sea Grant Programs (http://www.seagrant.noaa.gov/)

EBM programs could work with Sea Grant Programs to manage grants that reflect EBM goals. In California, the Sea Grant program administers a grant program for the California Ocean Protection Council. California Sea Grant received $800,000 to support grants that align with Ocean Protection Council objectives.[547] The first grants were issued in 2006, and work products are beginning to emerge. Ideally, the outcome of this research will inform the work of the Ocean Protection Council and help it adapt its strategy as it moves forward.

Each coastal state has a Sea Grant program that is funded in part by the federal government with matching funds from the state. The National Sea Grant Office administers the program and provides guidance and support to state programs. Recently, the National Sea Grant Office encouraged state Sea Grant programs to work together across regions to develop research agendas. This resulted in the development of eight regional projects focused on Alaska, Hawai`i, Great Lakes, Gulf States, Mid-Atlantic, Southeast Atlantic, New England, and the West Coast.[548] The four West Coast Sea Grant Programs (two in California, Oregon, and Washington) conducted a major regional research and information needs session. They convened sixteen workshops and received comments from more than 6,000 people—experts to general public.[549]

544 NOAA Coastal Services Center, *About the NOAA Coastal Services Center*, *at* http://www.csc.noaa.gov/text/gen.html.
545 Personal communication with CSC [Becky Smyth], Sept 19, 2009, on file with authors.
546 *Id.* [545]
547 Personal communication with California Sea Grant [Russell Moll], September 26, 2008, on file with authors.
548 Personal communication with California Sea Grant [Russell Moll], September 26, 2008, on file with authors.
549 For more information, *see* Oregon Sea Grant, *Collaborative Project: Regional Research and Information Plan*, *at* http://seagrant.oregonstate.edu/research/RegionalPlanning/.

This section examines the California Sea Grant program as an example. The program has three functions: (1) research, (2) outreach, and (3) education. Its research and education includes support to academic researchers and graduate students to better understand the coastal environment. Outreach is aimed at the informed layperson and typically targets specific communities or industries. The written outreach materials include pamphlets as well as one-page summaries of all research supported by Sea Grant. Sea Grant also employs several field agents throughout the region that have a wide variety of expertise related to the regional ocean and coastal ecosystem. Field agents typically engage with specific ocean stakeholders and provide a conduit between ocean research and ocean users.

LIST OF LAWS, AGREEMENTS, AND PLANS

The following is a list of federal and state laws, agreements and plans that are discussed in the Handbook.

Federal Laws

Antiquities Act
Atlantic Coastal Fisheries Cooperative Act
Chesapeake Bay Restoration Act of 2000
Clean Water Act
Coastal Zone Management Act
Comprehensive Environmental Response, Compensation, and Liability Act
Delaware River Basin Compact
Endangered Species Act
Energy Policy Act of 2005
Federal Power Act
Magnuson-Stevens Fishery Conservation and Management Act
Marine Mammal Protection Act
National Environmental Policy Act
National Marine Sanctuaries Act
National Wildlife Refuge System Improvement Act of 1997
Northwest Electric Power Planning and Conservation Act
Oil Pollution Act
Park System Resource Protection Act
Recreation Act
Refuge Administration Act

State Laws

California Marine Life Protection Act
California Marine Managed Areas Improvement Act of 2000
California Ocean Protection Act
California Ocean Resources Stewardship Act of 2000
Massachusetts Oceans Act
New York Ocean and Great Lakes Ecosystem Conservation Act
North Carolina Fisheries Reform Act
Washington Statute establishing the Puget Sound Partnership

Agreements

Boundary Waters Agreement (binding treaty)
Chesapeake 2000
San Francisco Bay Delta Agreement
West Coast Governors Agreement on Ocean Health

Plans

Aleutian Islands Fishery Ecosystem Plan
California Ocean Protection Council Strategic Plan
Chesapeake Bay Fishery Ecosystem Plan
Gulf of Maine Council on the Marine Environment 2007-2012 Action Plan
Gulf of Mexico Alliance Action Plan
North Carolina Coastal Habitat Conservation Plan
Puget Sound 2020 Action Agenda
West Coast Governors Action Plan

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